Atty. Dkt. No. 029319-0201

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Jay A. Haines

Title: INFRARED REFLECTIVE WALL PAINT

Appl. No.: 10/811,065

Filing Date: 3/26/2004

Examiner: Alain Bashore

Art Unit: 1762

Conf. No.: 8080

CERTIFICATE OF MAILING
I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail in an envelope addressed to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**, on the date below.

Vanessa E. Agha
(Printed Name)

Vanessa E. Agha
(Signature)

August 24, 2006
(Date of Deposit)

DECLARATION OF ANDRÉ DESJARLAIS UNDER 37 CFR 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, André Desjarlais, hereby declare as follows:

1. I hold the degree of B.S. in aeronautics from Boston University, conferred in 1973, and I have completed substantial coursework towards an M.S. at the Massachusetts Institute of Technology.

2. From 1975 until 1991, I was employed by the Dynatec company where my responsibilities focused on energy study consulting.

3. I am currently employed by the Oak Ridge National Laboratory of the United States Department of Energy in the position of Program Manager of the Building Envelope Group, which position I have held since 1991.

4. I am an expert in the field of architectural energy conservation by virtue of my training and professional research experience.

5. My laboratory engaged in a cooperative research project with Textured Coatings of America, Inc. in 2004 and 2005 to compare by actual field test the thermal performance of walls coated with Cool Wall (i.e., high infrared reflectance) as compared with standard colors, using Textured Coatings of America's Supercote Platinum and Supercote products. The term "standard colors" refers to paint which is not categorized as highly infrared reflective.

6. The results of that research,, entitled "Field Tests of Cool Walls in Cooling and Mixed Climates," are summarized in Exhibit 1 provided herewith. The project involved monitoring inside and outside temperatures and solar radiation levels of homes in various climates, and then using these data to make refined computer model simulations of the cooling costs associated with each site.

7. To summarize the results of this project, Exhibit 1 at page 47 provides the annual electricity burden for cooling the buildings of the model. The savings in energy to cool homes coated with infrared reflecting versus standard paint varied from 4-21.9%. The study concluded that using infrared reflective paint on the outside walls of homes results in a substantial increase in efficiency, relative to using paint which is not infrared reflective.

8. To reiterate, I was surprised at the magnitude of the savings afforded by the method of painting the exterior vertical walls of the test buildings with infrared reflective paint. In order to provide historical perspective to this study described in Exhibit 1, it must be understood that at the beginning of the cooperative research project (i.e., 2004) the collective wisdom in the field of architectural energy conservation dictated that the most efficient use of infrared-reflective paint ~~would be on roofs. The idea was discounted in the professional wisdom that simply coating the~~ exterior vertical walls of a building with an infrared-reflective paint could result in the significant energy savings which my group observed in the project summarized in Exhibit 1. The reason for the professional skepticism, and the resultant lack of research into exterior vertical wall infrared reflectance, is that the roof typically takes the majority of solar radiation impinging on a building. Prior to my laboratory's cooperative research project with Textured Coatings of America, Inc., I am not aware of any other work whatsoever directed to energy savings through heat-reflective

exterior vertical wall coatings. Thus, virtually all infrared-reflective coating research in the time period of 2004 was focused on roof coatings. I personally organized a seminar on the advantages of cool (i.e., heat reflective) roofing at the annual meeting of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, held in Anaheim, CA, January 24-27, 2004.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information or belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the captioned patent application or any patent issued therefrom.

Respectfully submitted,

Date 10 Dec. 06

André Desjarlais

Exhibit 1: Field Tests of Cool Walls in Cooling and Mixed Climates, André Desjarlais, Progress Report on Joint Research Project, Textured Coatings of America and the Oak Ridge National Laboratory, 28 October 2005

UT-BATTELLE

Field Tests of Cool Walls in Cooling and Mixed Climates

André Desjarlais

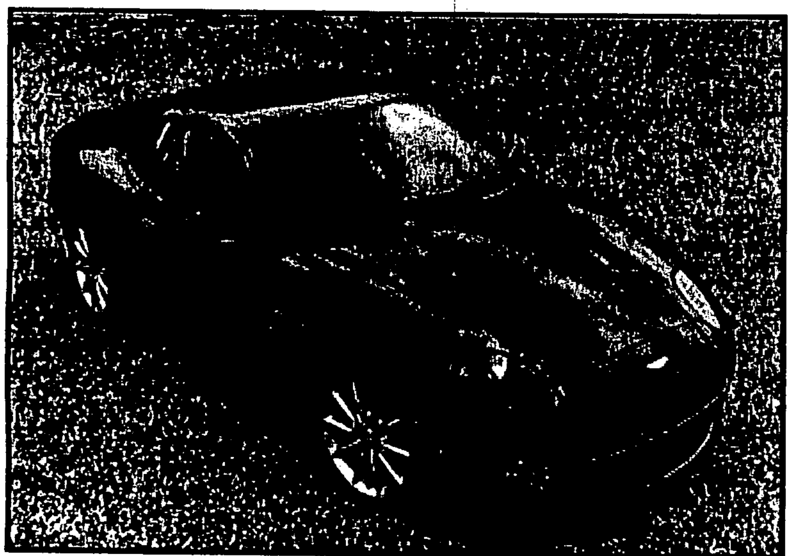
Progress Report on
Joint Research Project

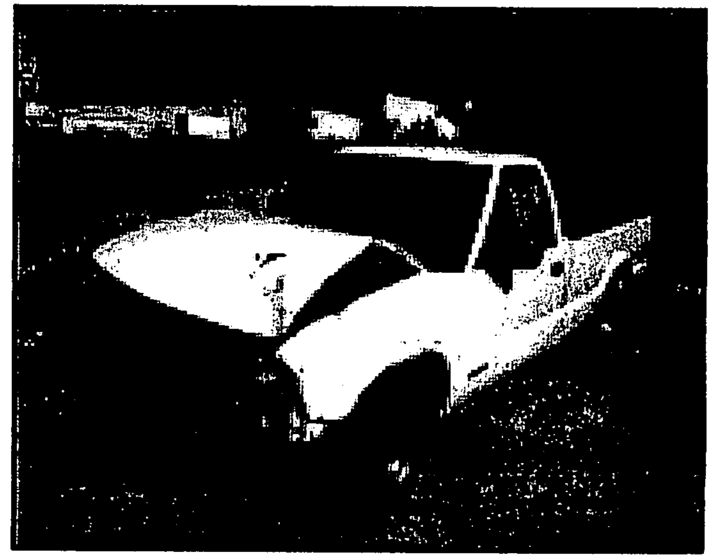
Textured Coatings of America
and the
Oak Ridge National Laboratory

28 October 2005

OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY

Quiz



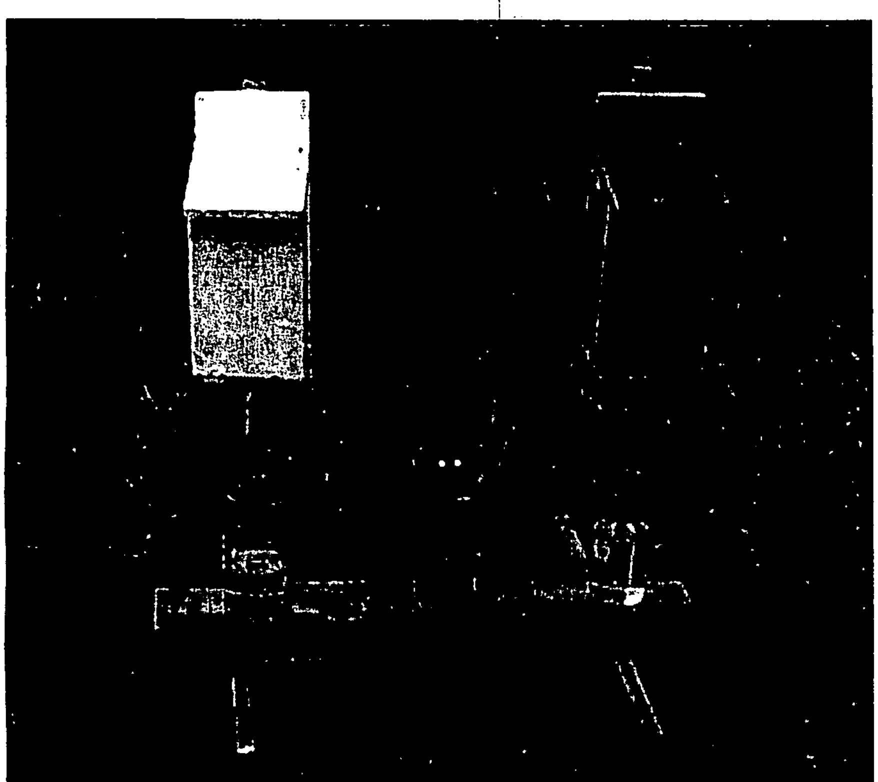


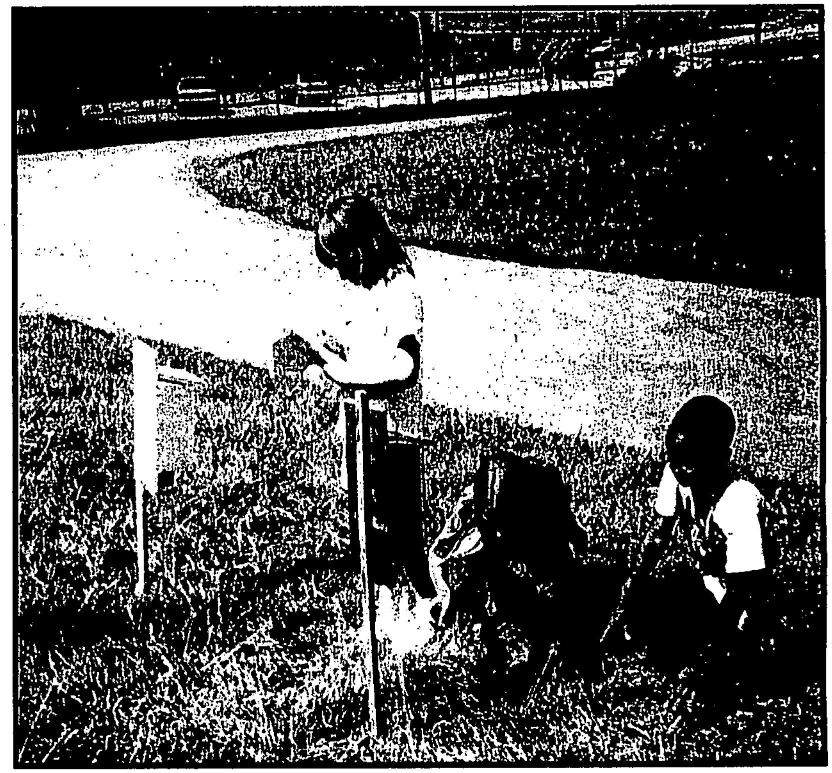
With <u>Comfort and Energy Efficiency</u> in mind, which car do you select to drive in the Panama City during the summer?

Potential Answers

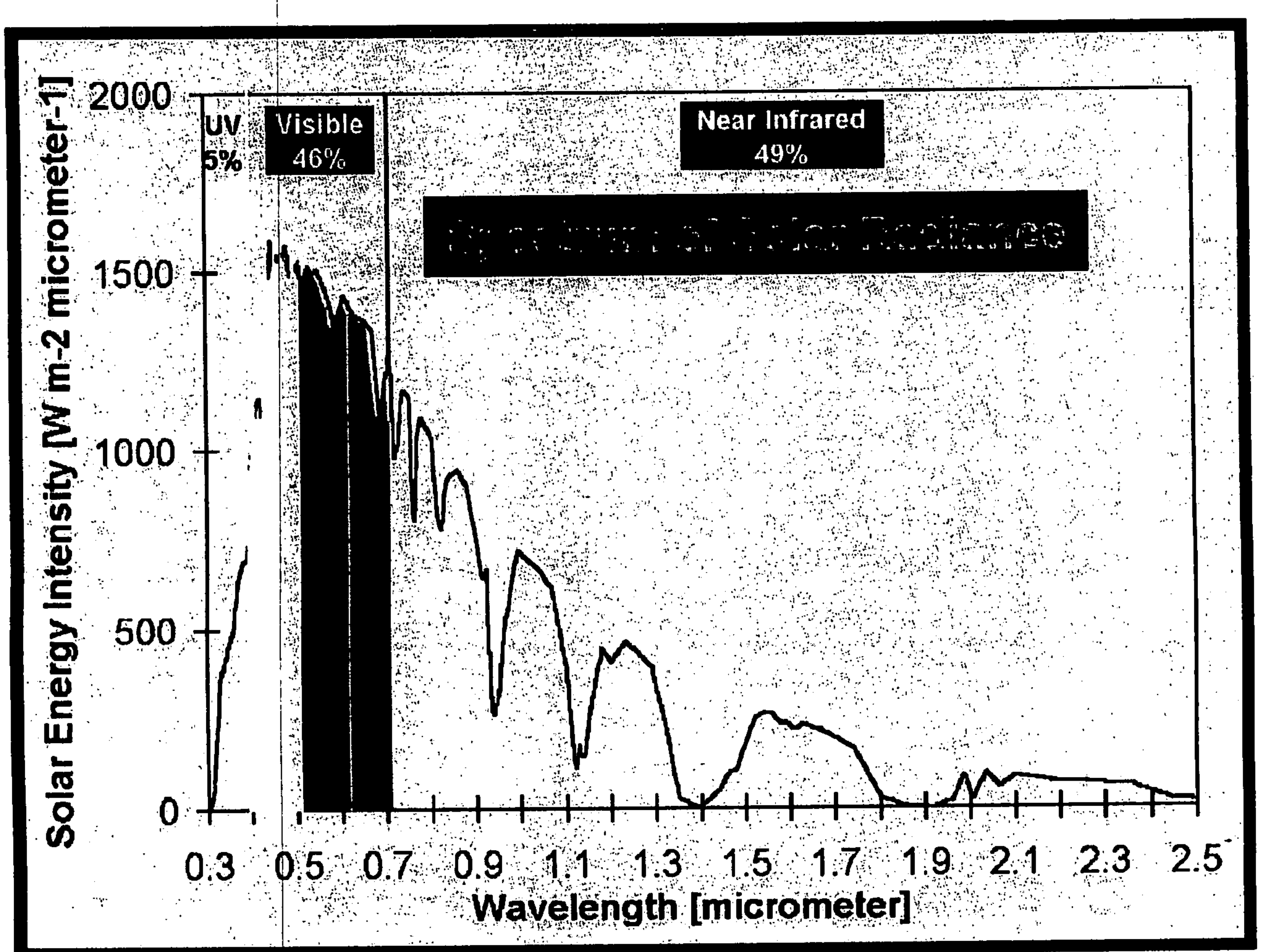
- The black car (!)
- The white car
- Pick the black car and move to Denmark
- Who cares about energy efficiency or comfort?

Proof of Concept



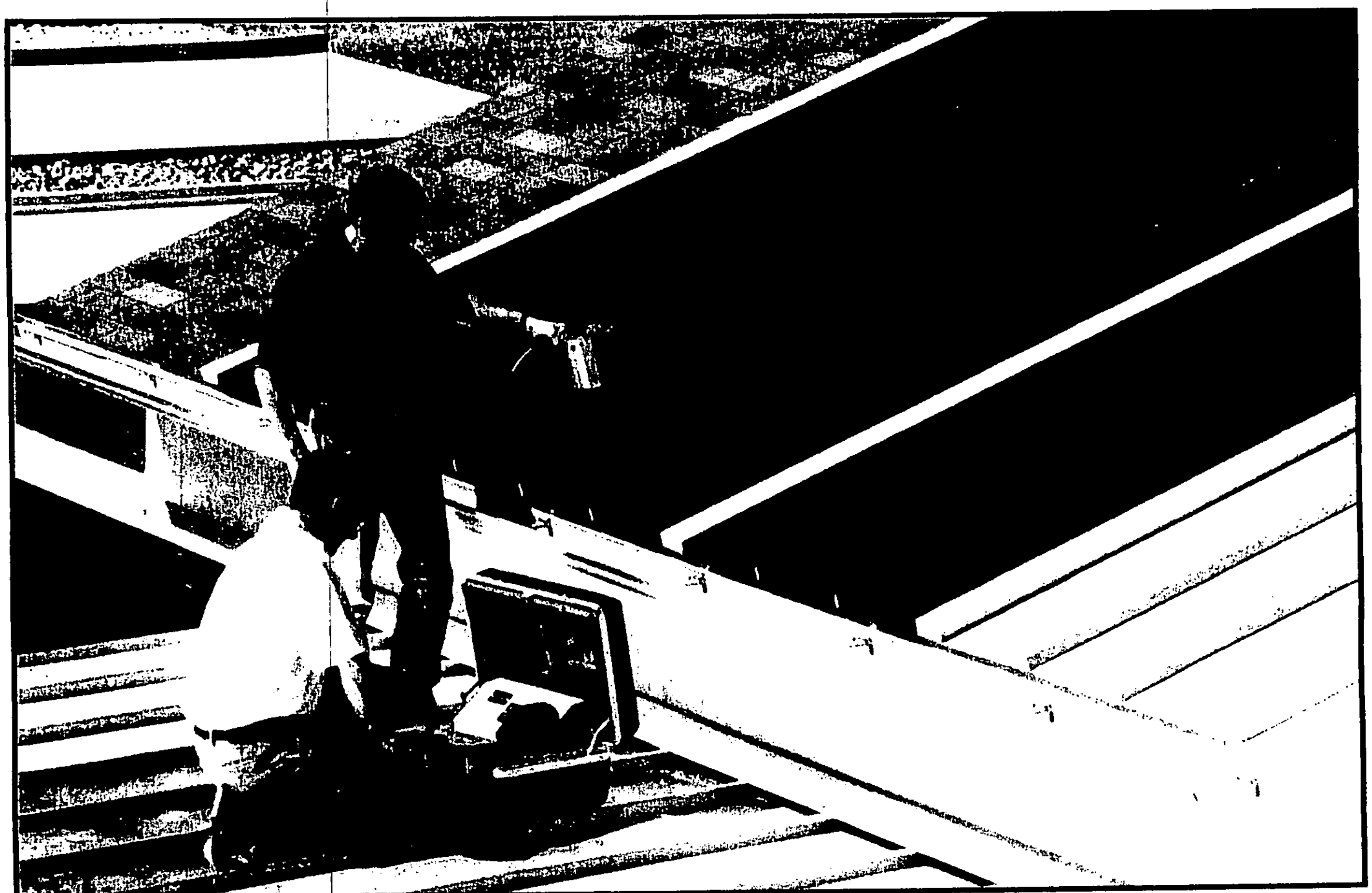


Solar Energy Spectrum

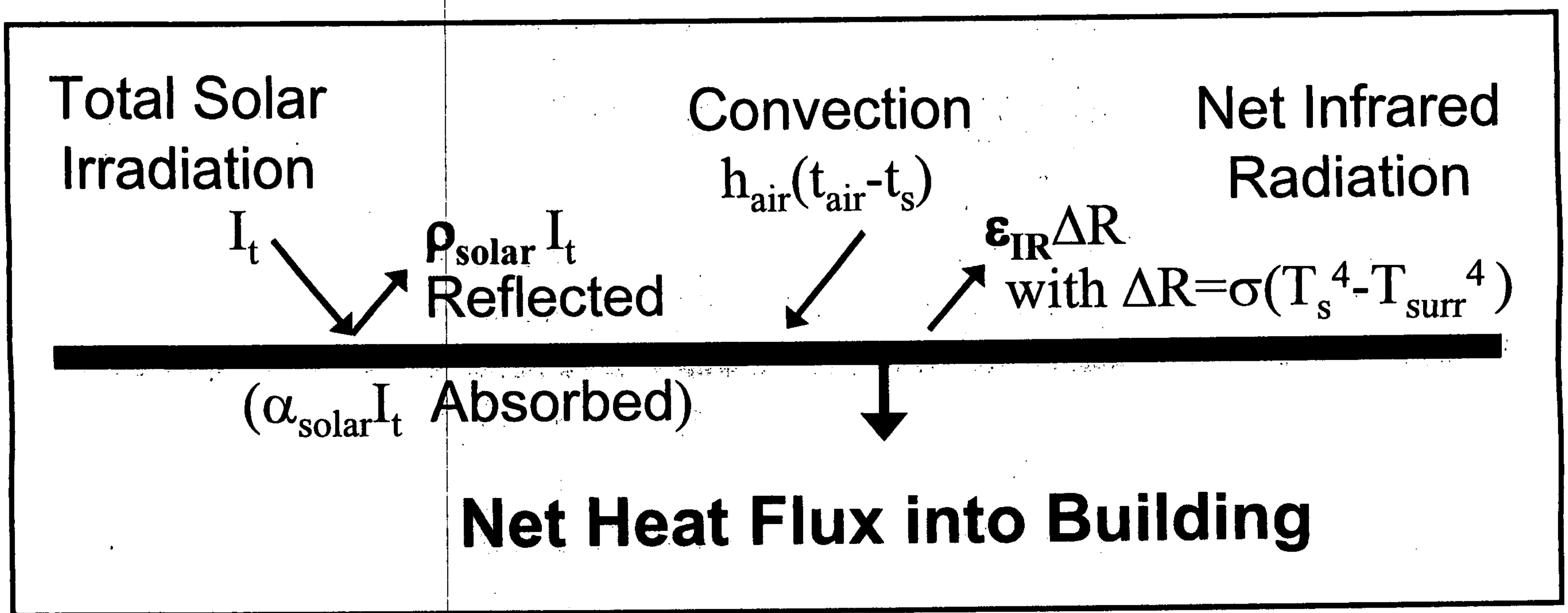


Critical Properties

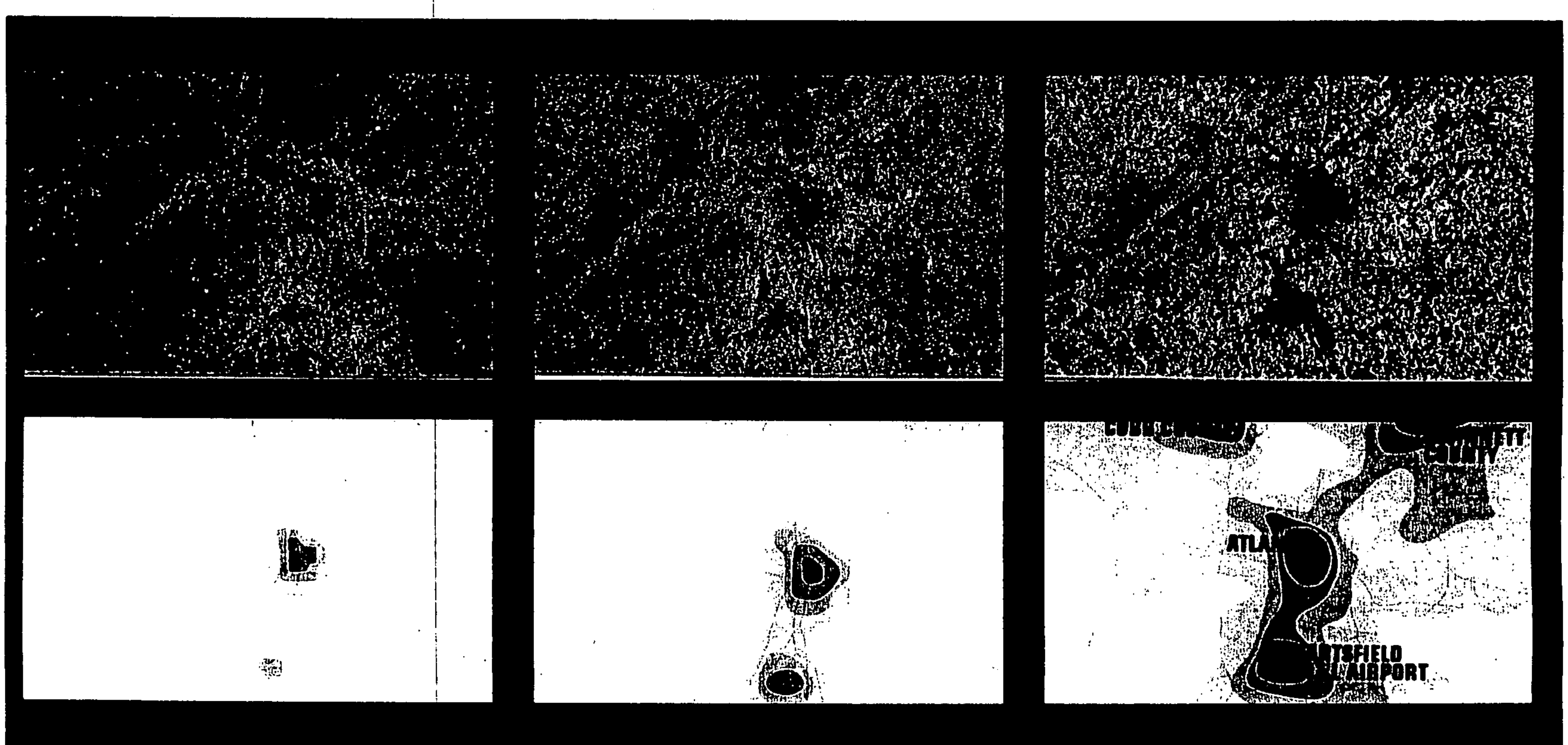
Reflectance (ρ_{solar}) Emittance (ε_{IR})



ρ_{solar} and ε_{IR} are Both Very Important



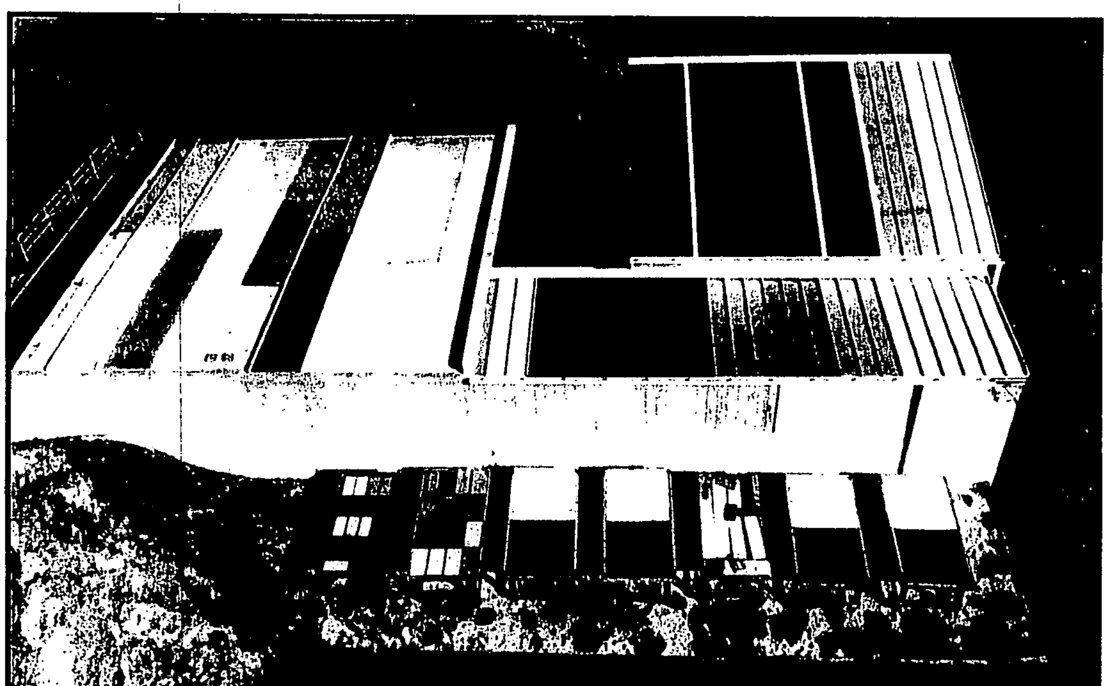
Atlanta's Changing Environment



1972 1978 1993

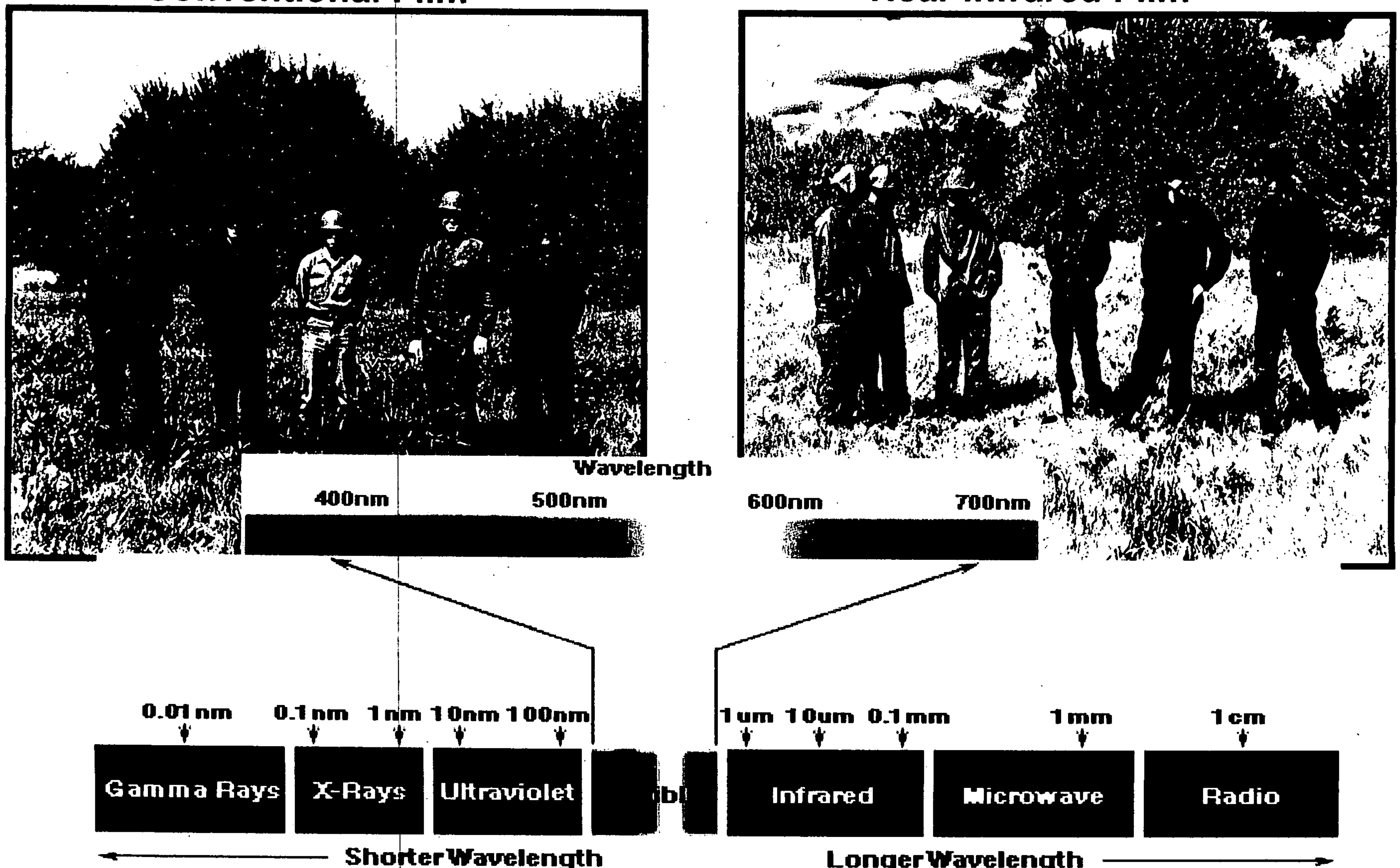
Working with Industry Partners

- Team with metal roof, single ply membrane, and roof coating associations and their members and Textured Coatings
- Federally co-funded

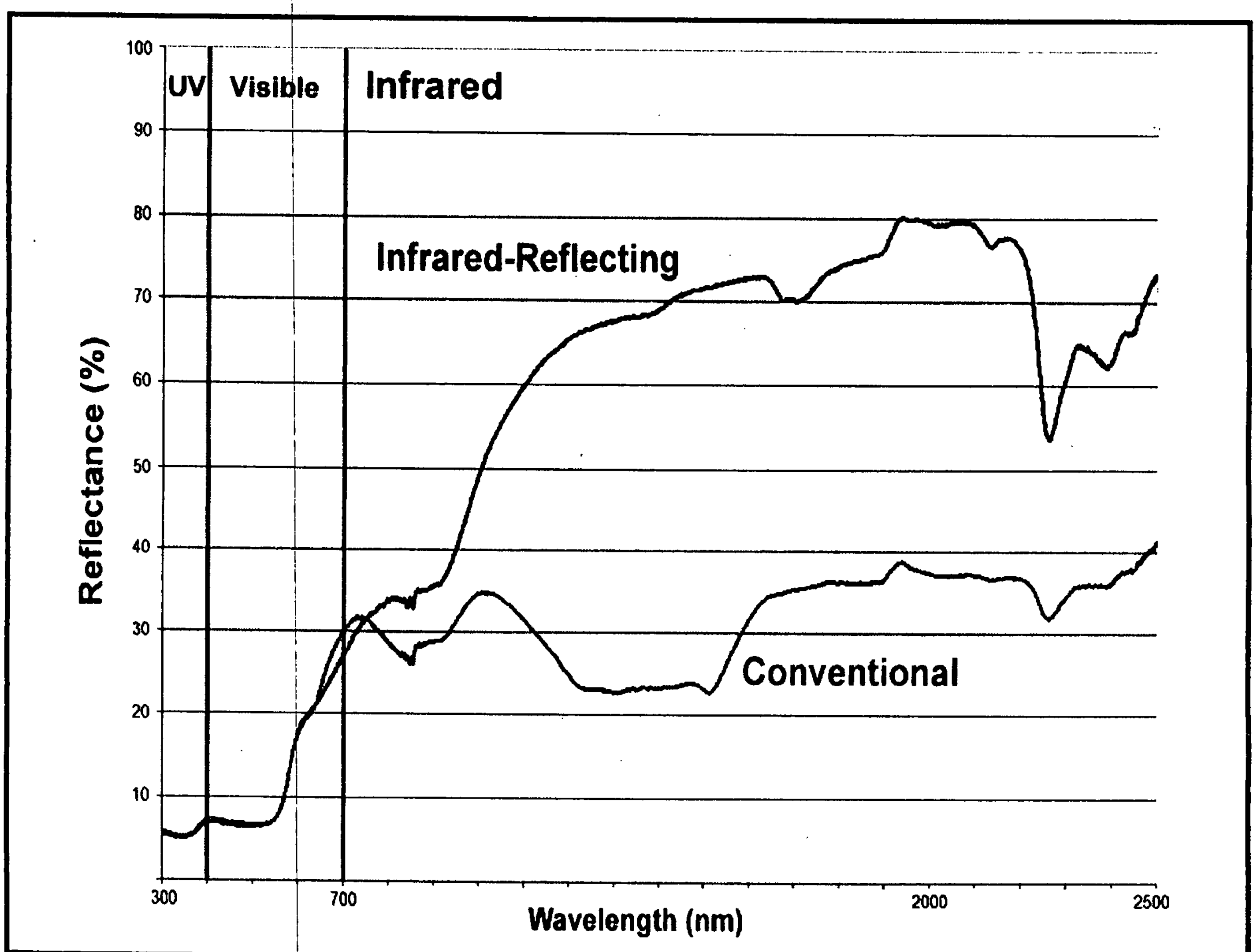


Camouflage Invisible to Night Vision

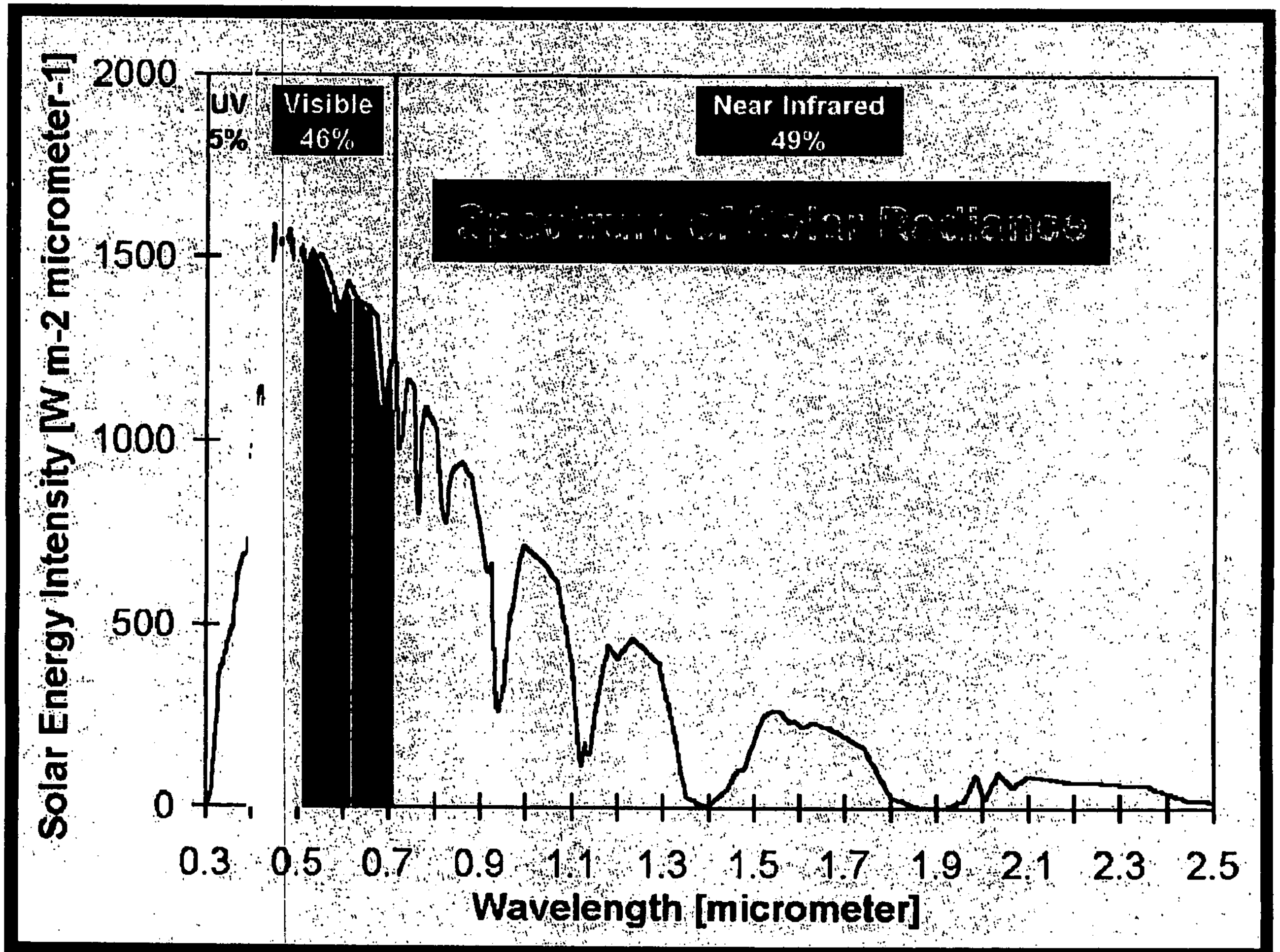
Conventional Film | Near Infrared Film



Conventional vs. Infrared Pigments



Solar Energy Spectrum



Overview: Scope of Work

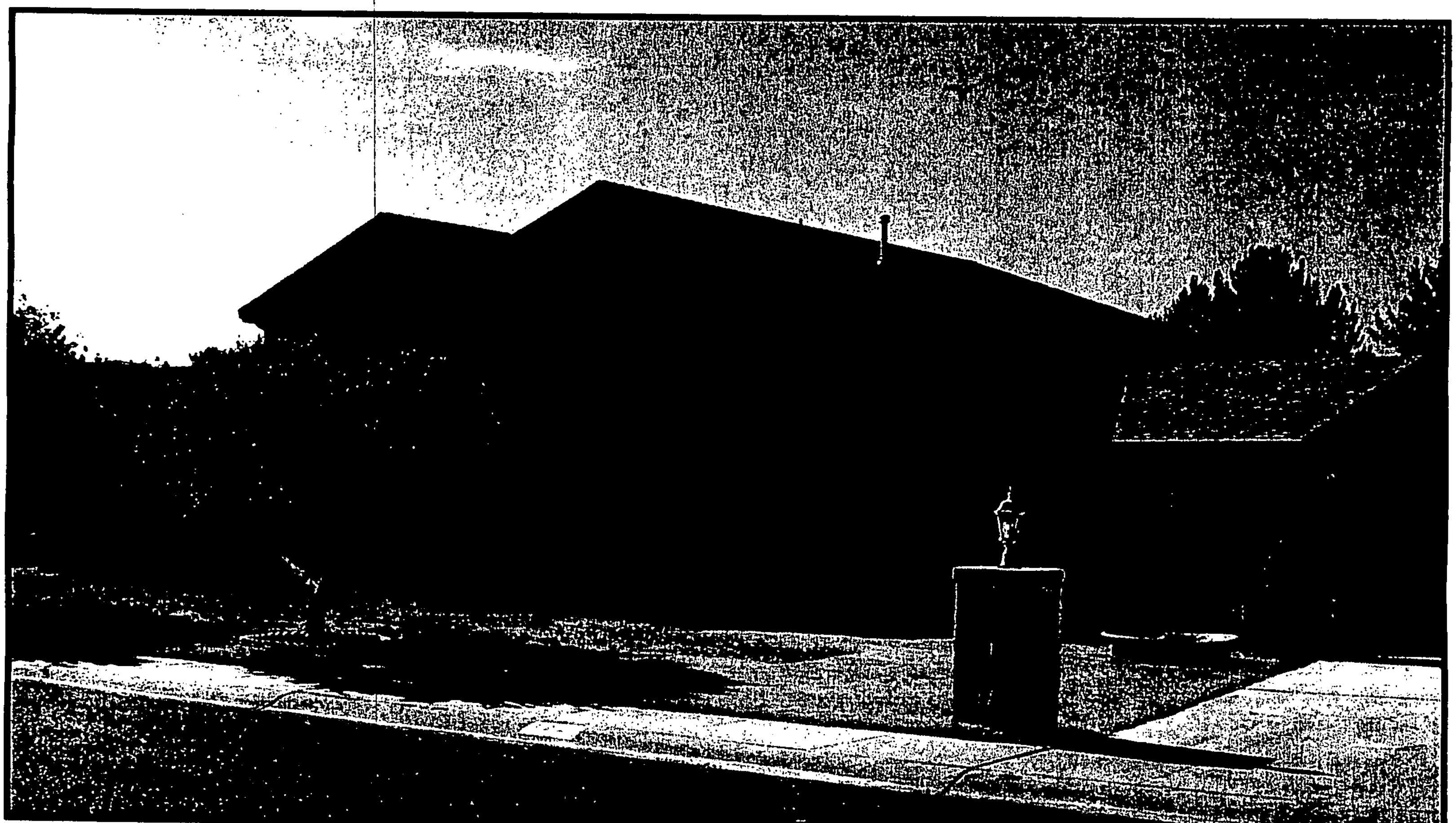
- Compare thermal performance of walls with cool (high infrared reflectance) and standard colors
- Use Textured Coatings of America's SuperCote Platinum and SuperCote products

Overview: Scope of Work

- Phoenix site: Stucco-coated with various constructions facing east, south, southeast and southwest already covered with Mountain Gray color. Install instrumentation and recoat test areas.
- Jacksonville site: Wood siding facing south already covered with Underseas color. Install instrumentation and recoat test areas.
- Oak Ridge campus site: Bare stucco-coated test area facing south. Add instrumentation; prime and coat test areas.

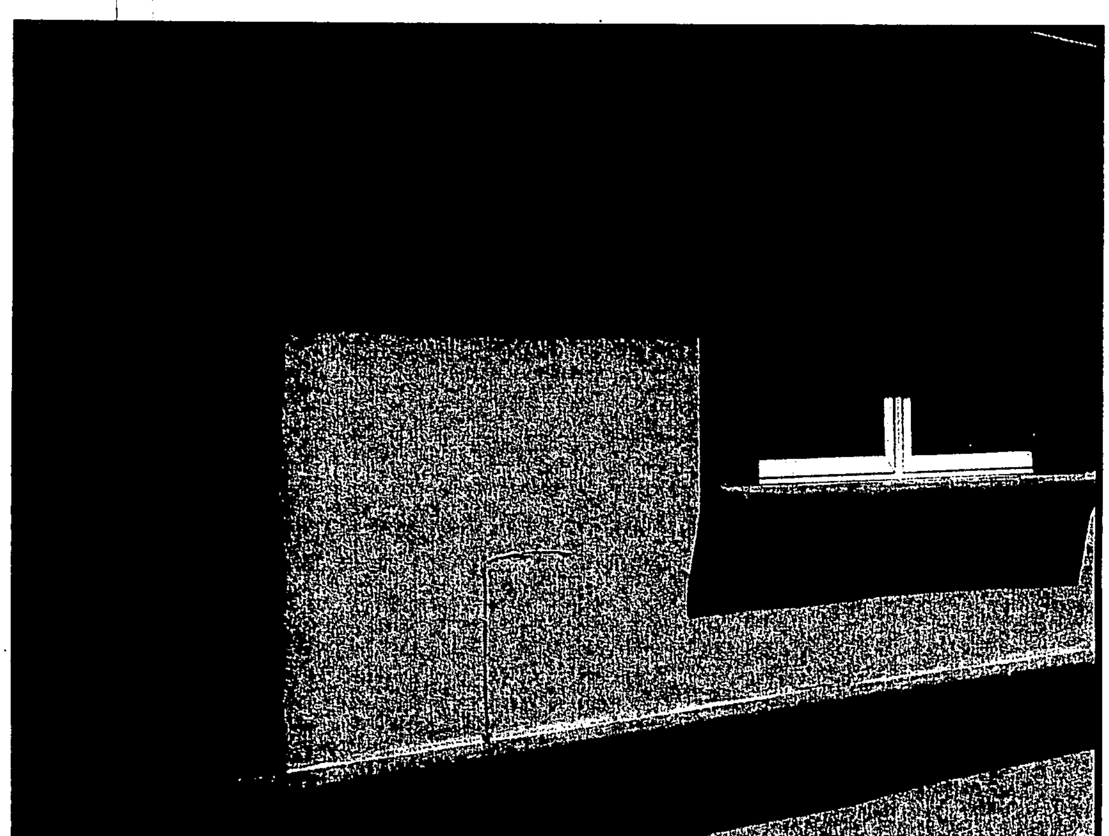
Phoenix Site

- Single-story wings with central vaulted ceiling area for family room + dining room/kitchen



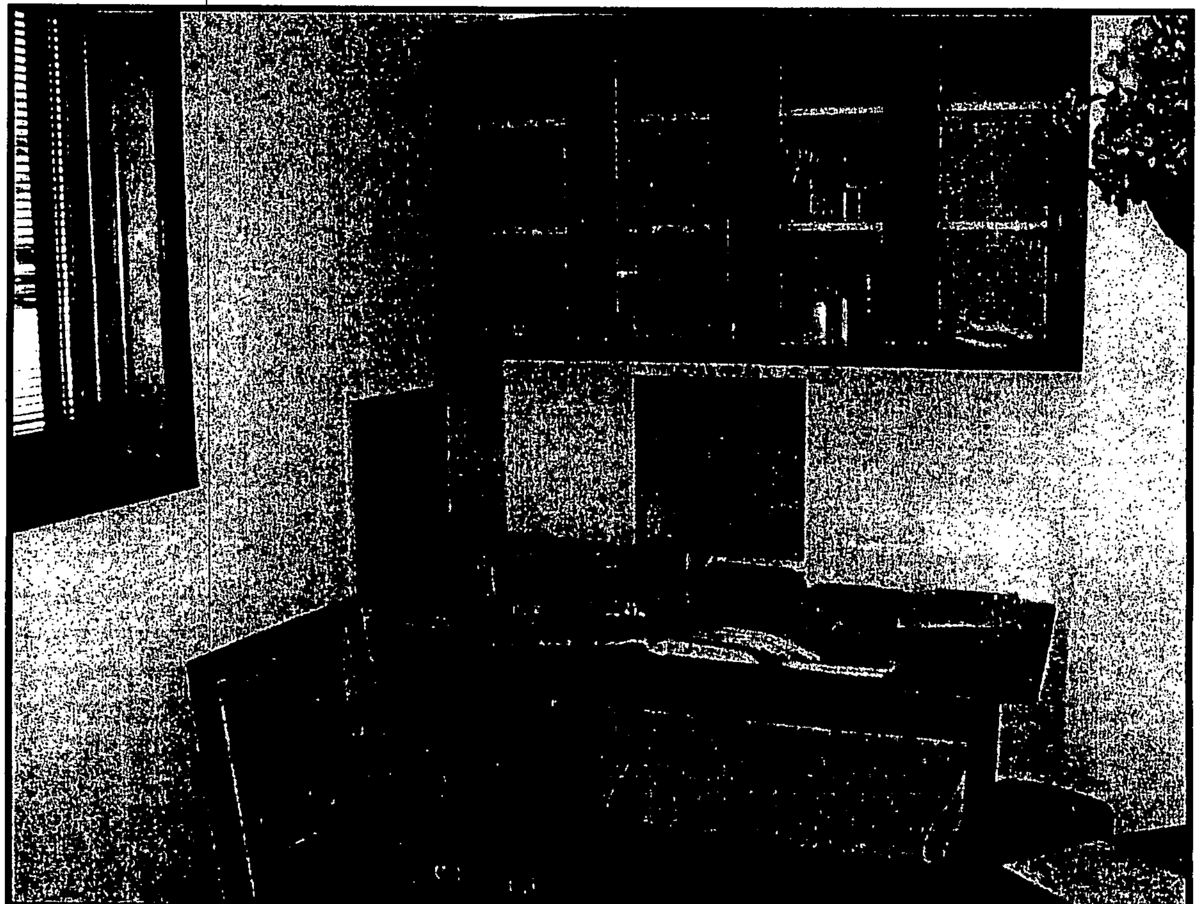
Phoenix Site

- Southeast and southwest exposures on walls of office in west wing. Outside temperature sensors attached to $10\frac{3}{4}$ in. thick walls



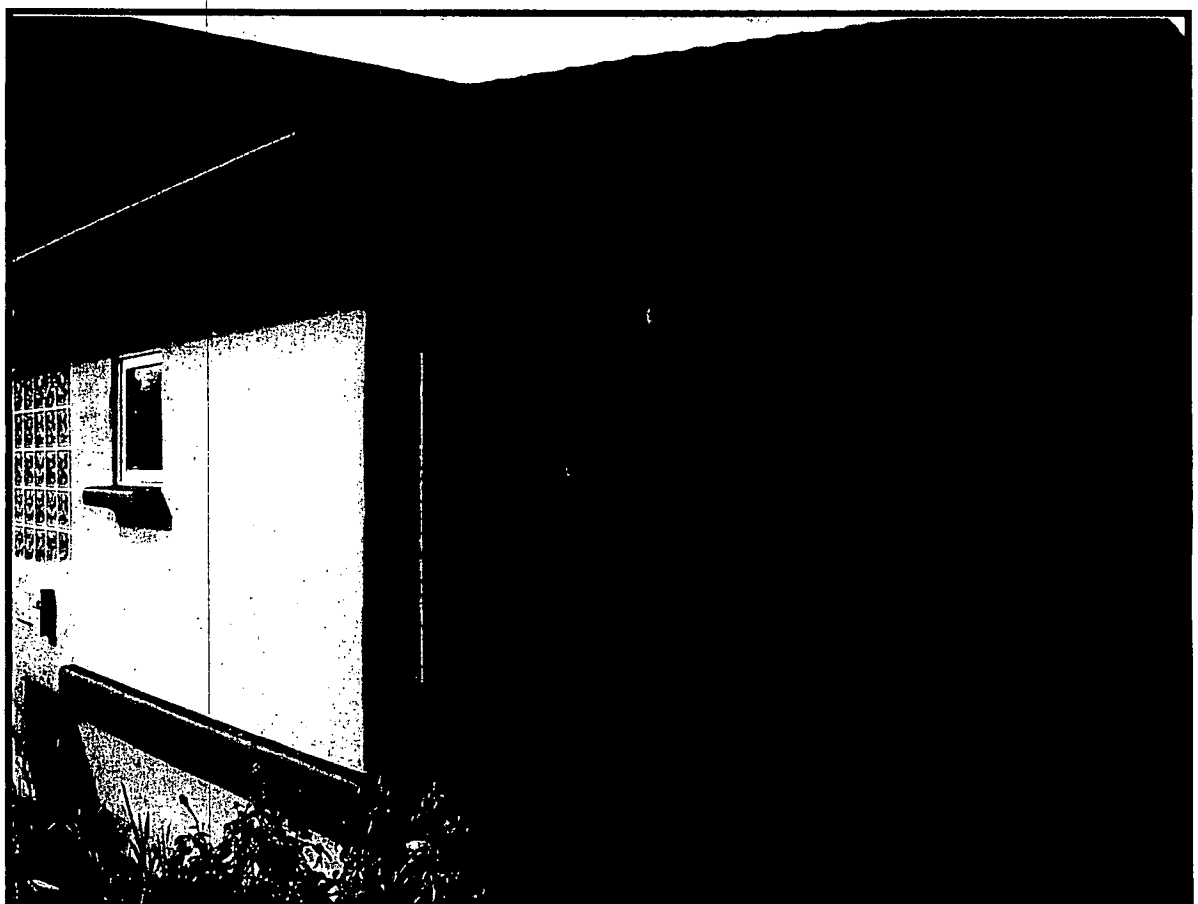
Phoenix Site

- Add gypsum panels for instruments to sense inside temperatures and heat flow through walls



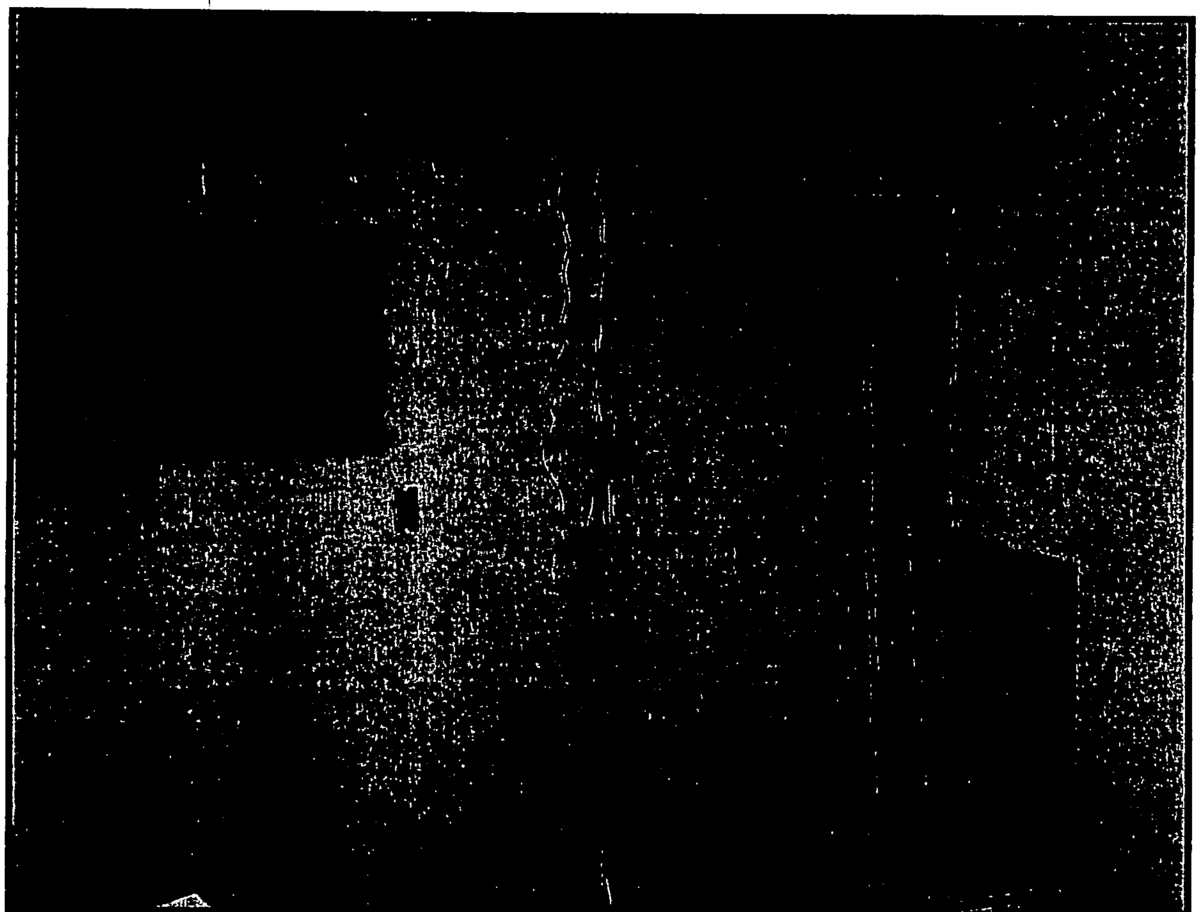
Phoenix Site

- South and east exposures on walls of exercise room. South 15 in. thick; east 6¼ in. thick



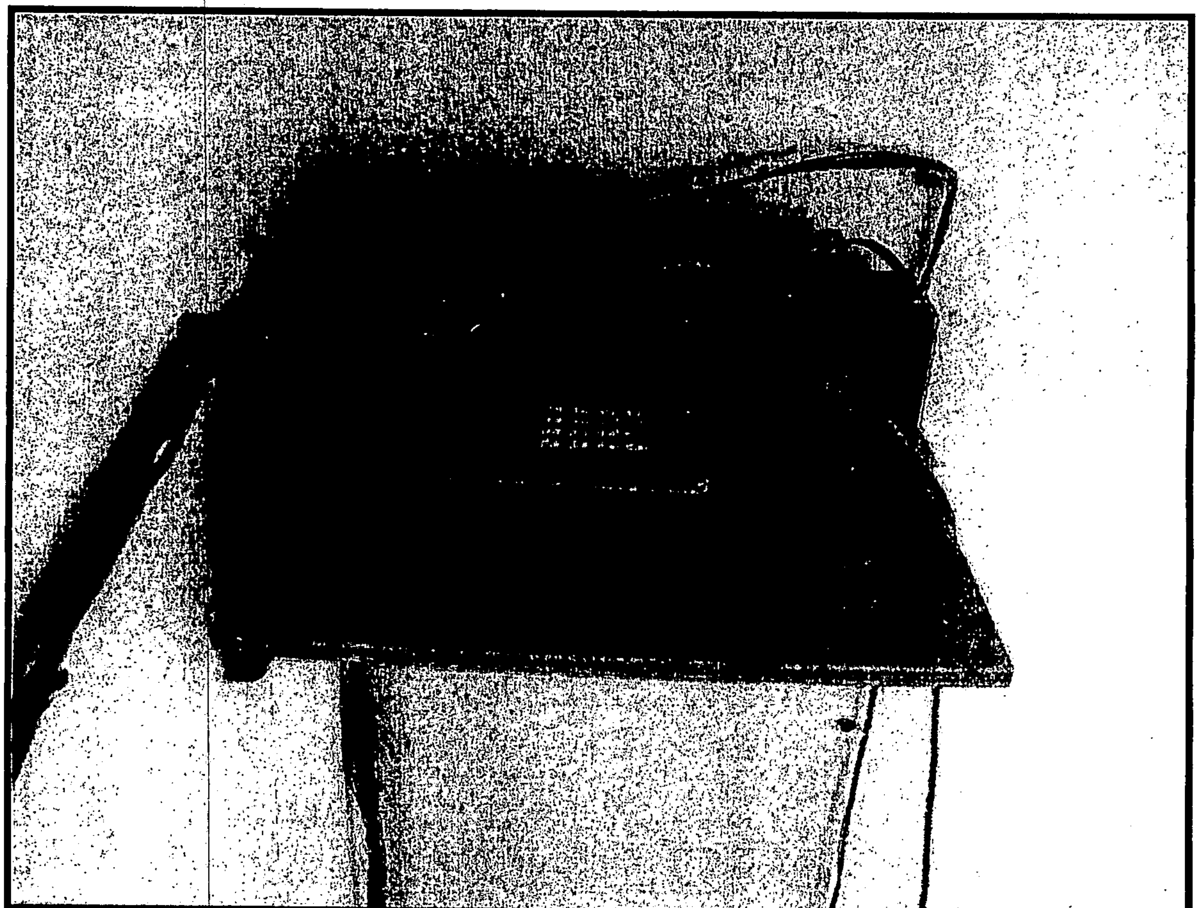
Phoenix Site

- Data logger and modem in exercise room. Wires from west wing in shallow trench through yard



Phoenix Site

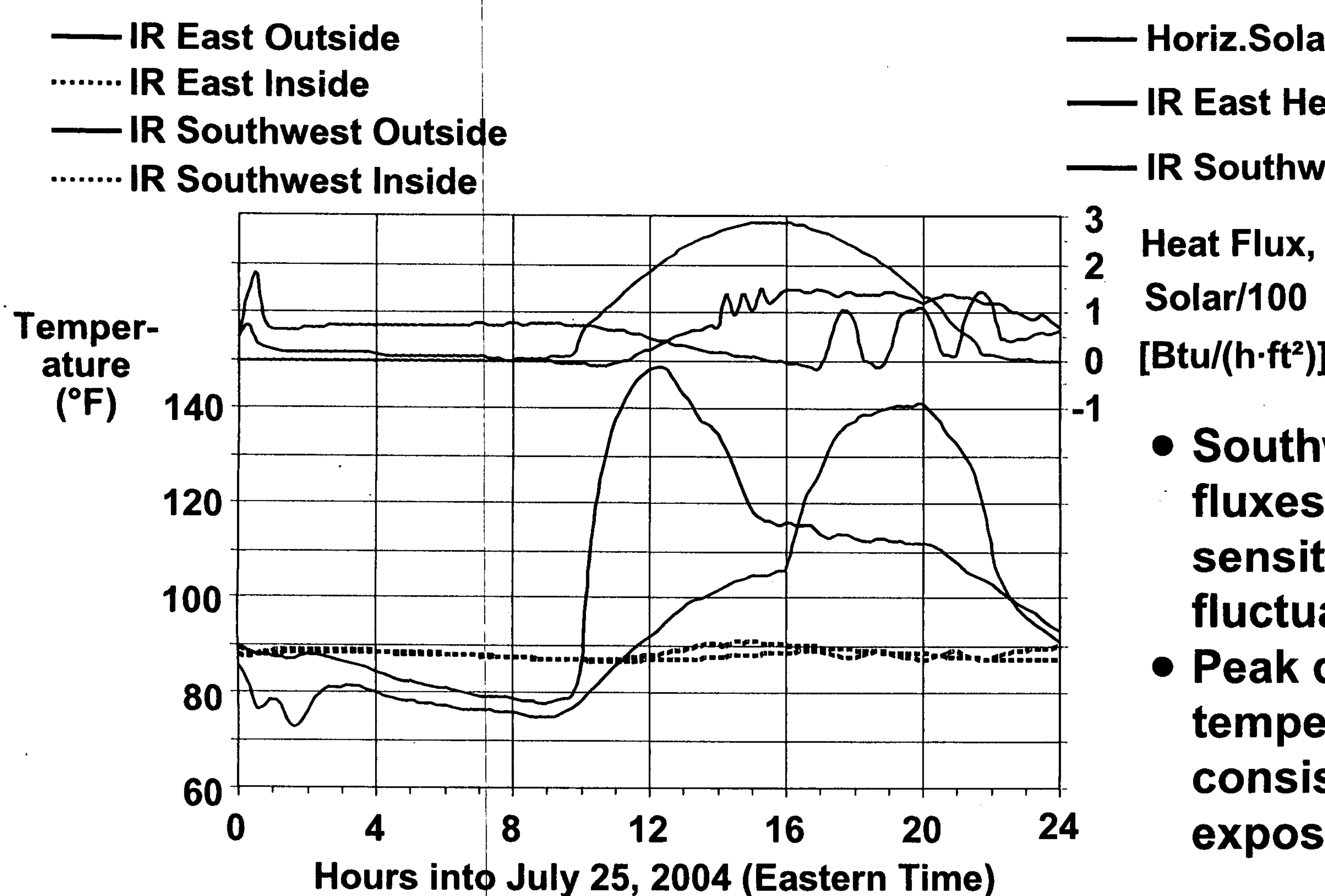
- Data logger transmits data through modem to computer at Oak Ridge over dedicated line



Phoenix Site

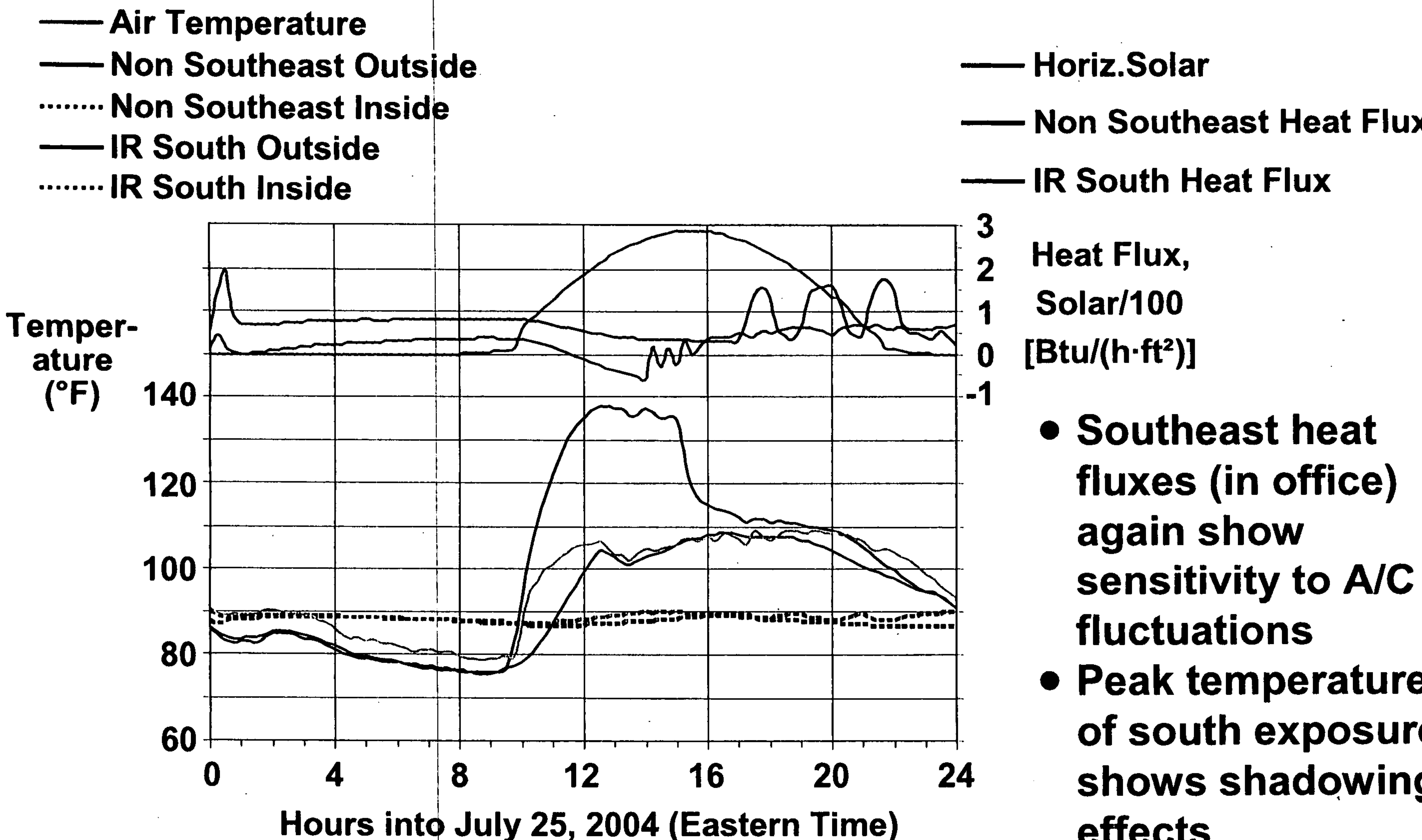
- Data obtained 5/2/04 through 11/30/04. Remove instrumentation on 12/2/04.
- Check consistency of data with program that estimates wall properties from measured temperatures and heat fluxes. R-values vary as expected.
- Different directions of exposure and varying thickness make it tough to interpret data.
- Limited height of walls and decorative overhang cause shadowing problems.

Phoenix Site: IR East vs IR Southwest



- Southwest heat fluxes (in office) sensitive to A/C fluctuations
- Peak daytime temperatures are consistent with exposure

Phoenix Site: Non Southeast vs IR South



- Southeast heat fluxes (in office) again show sensitivity to A/C fluctuations
- Peak temperature of south exposure shows shadowing effects

Jacksonville Site

- Two-story house on Ponte Vedra beach

Jacksonville Site

- South-facing test exposures outside family room above steps from deck that faces ocean

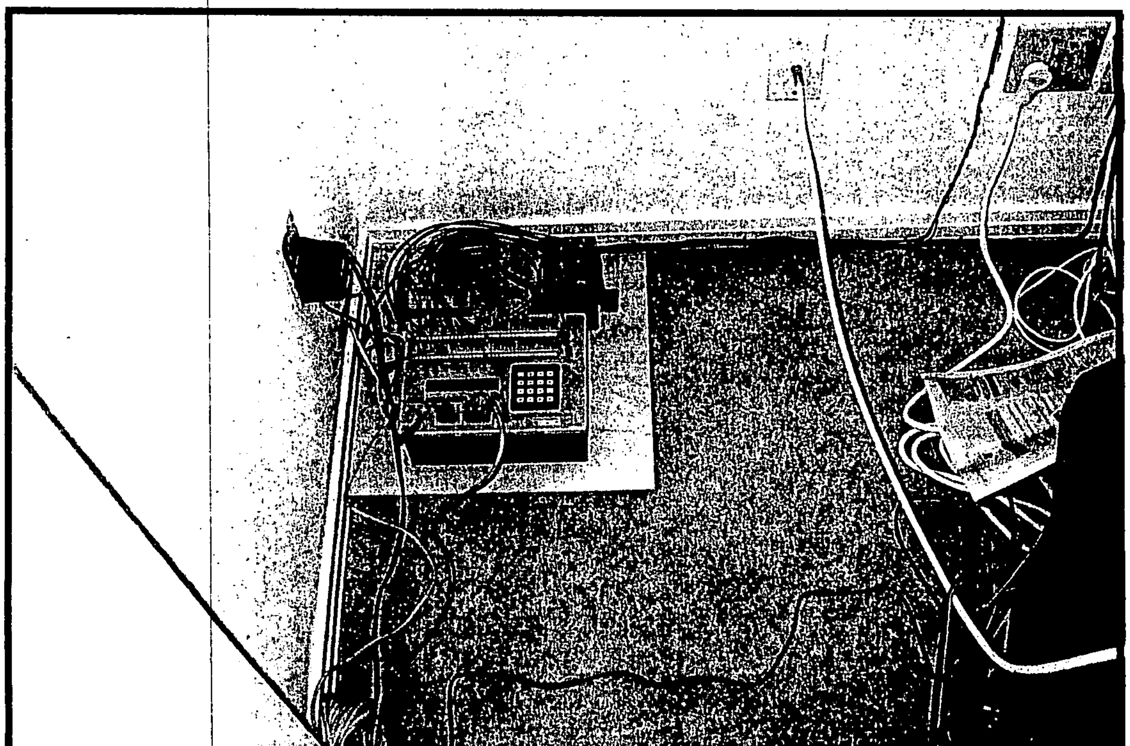
Meter for wall solar between test areas

Jacksonville Site

- Gypsum panels on inside walls painted to match existing decor

Jacksonville Site

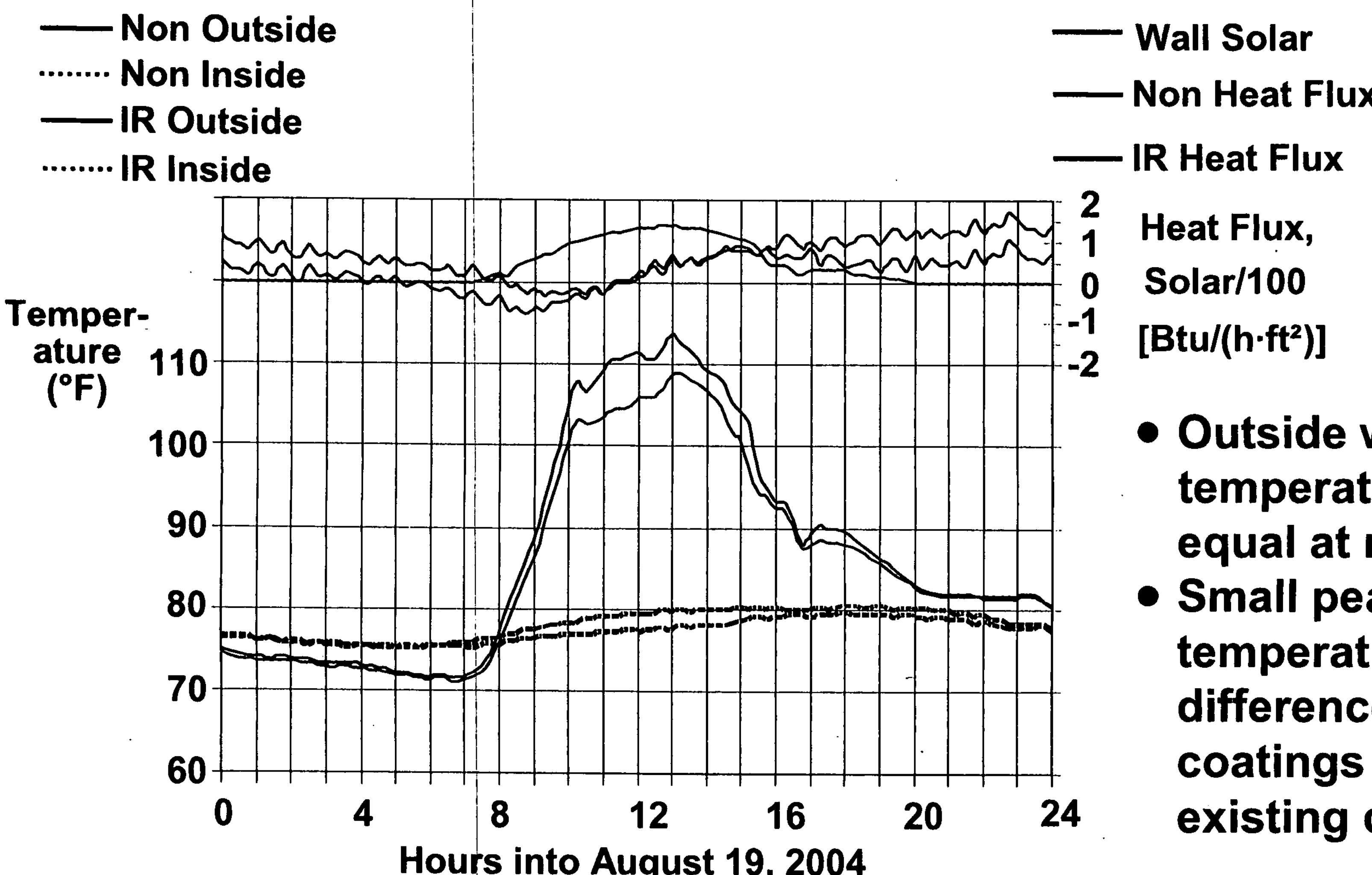
- Data logger and modem tucked into corner behind TV. Used house phone line for monthly download. Owner plugged in phone line for call



Jacksonville Site

- Data obtained 5/5/04 through 12/3/04 with recoating on 7/9/04. Remove instrumentation on 12/8/04
- Behaviors of solar flux incident on wall and outside surface temperatures show more cloudiness and rain than in Phoenix. Saw effects of Hurricanes Frances and Jeanne
- Exposures not at same level (followed slope of steps) so some height effects both outside and inside
- Railing for steps and enclosure for fireplace flue cause shadowing.

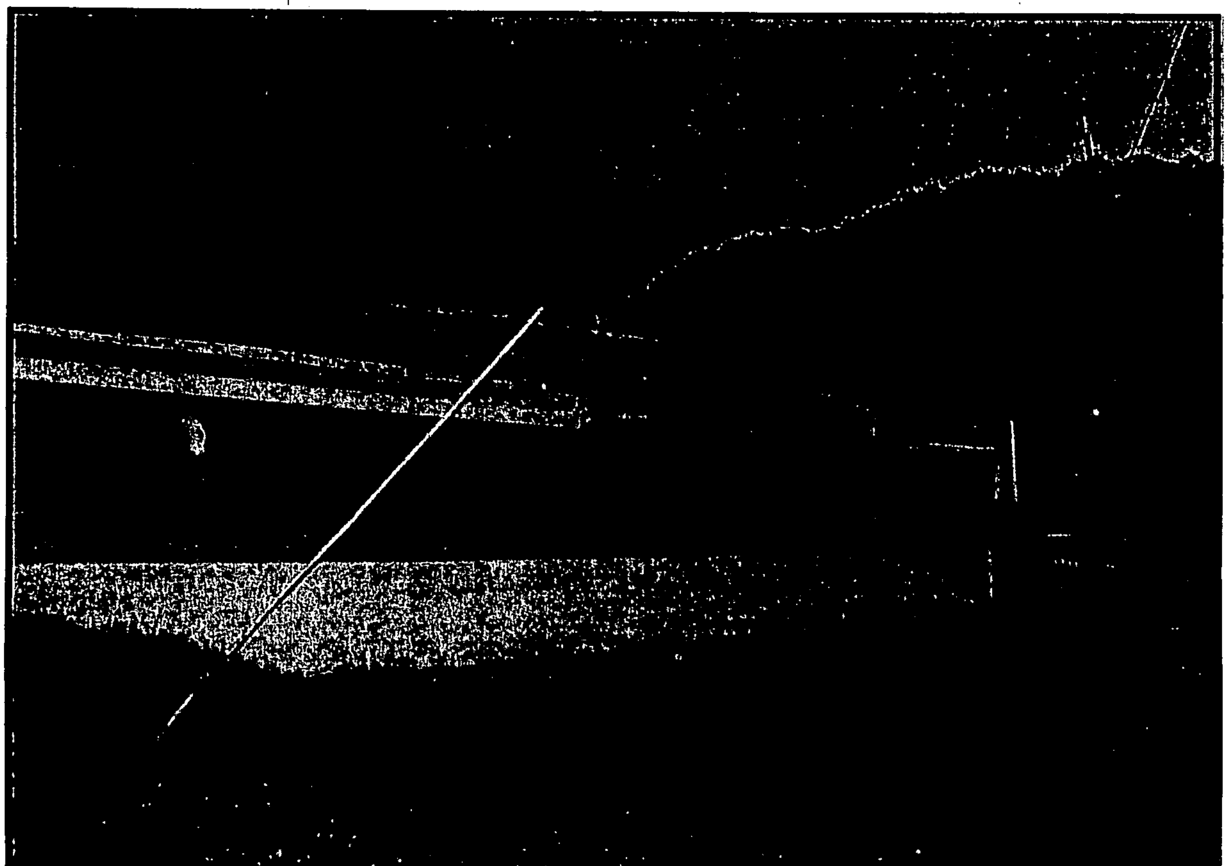
Jacksonville Site: Non Lower VS IR Upper



- Outside wall temperatures equal at night
- Small peak temperature differences: coatings over existing coating

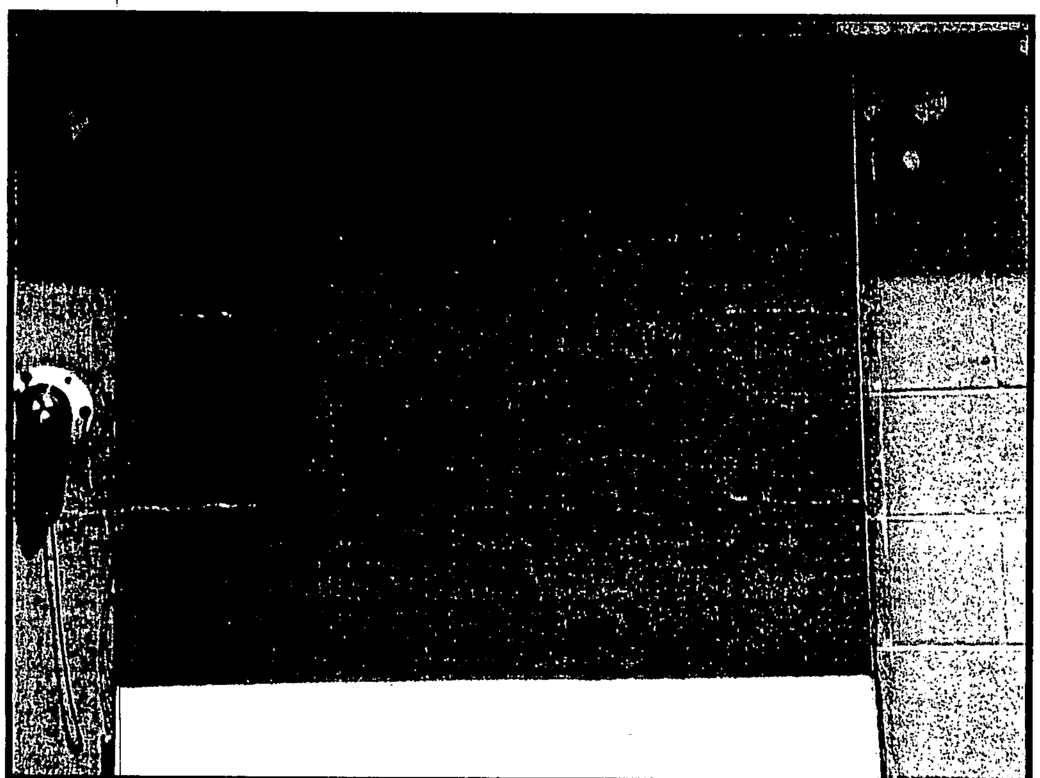
ORNL Site

- Stucco test section on south wall of Envelope Systems Research Apparatus (ESRA)



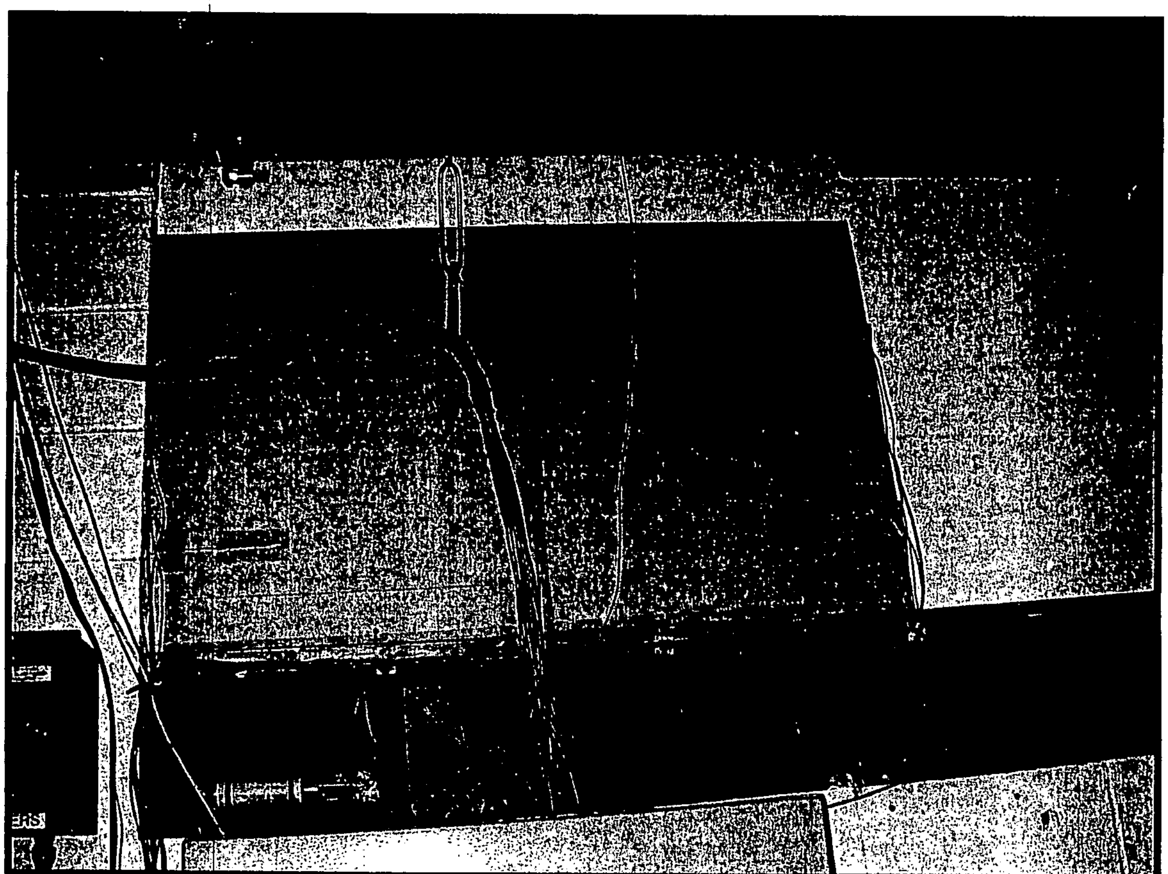
ORNL Site

- Underseas Supercote Platinum (IR) on right stud space and upper half of middle; Supercote (Non) on rest except for strip of uncoated primer at bottom



ORNL Site

- Add gypsum panels on inside like at Phoenix and Jacksonville sites

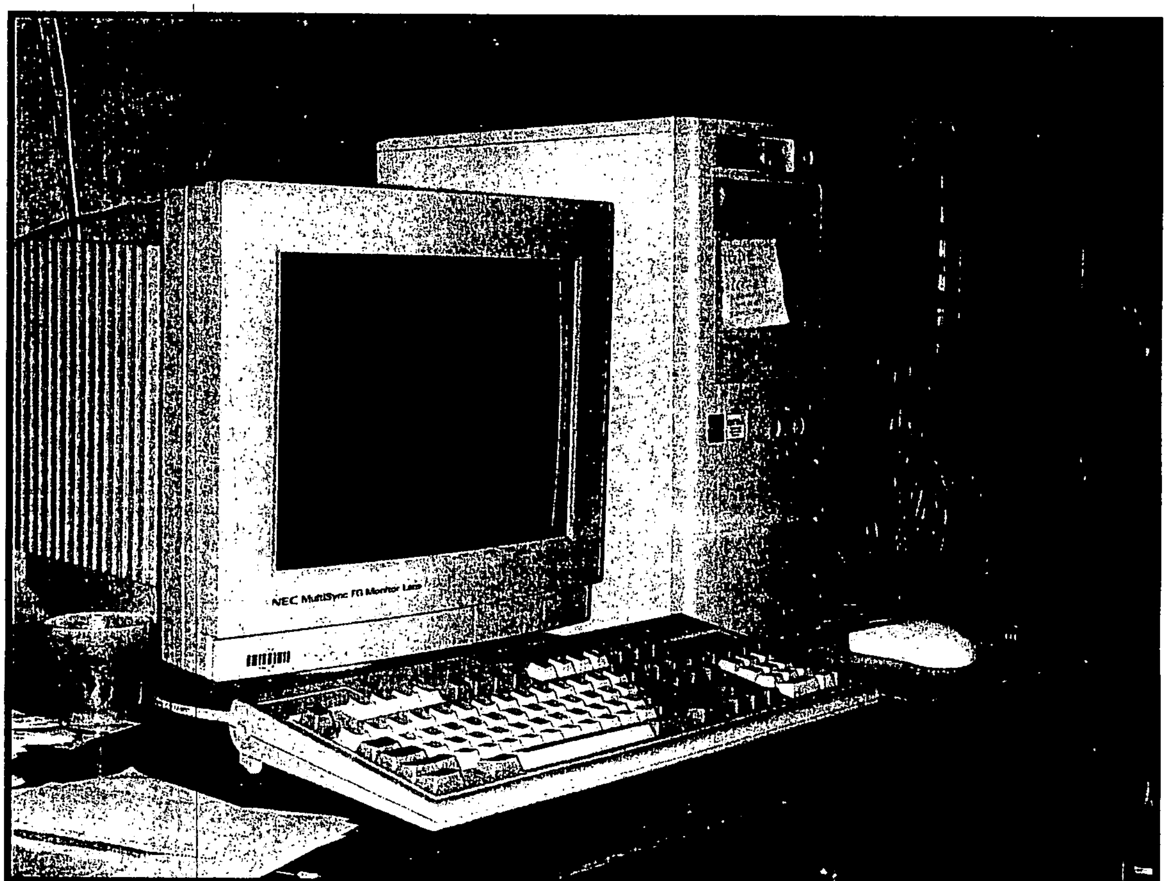


ORNL Site

- Have ESRA data acquisition system in place and complete weather station next door

ORNL Site

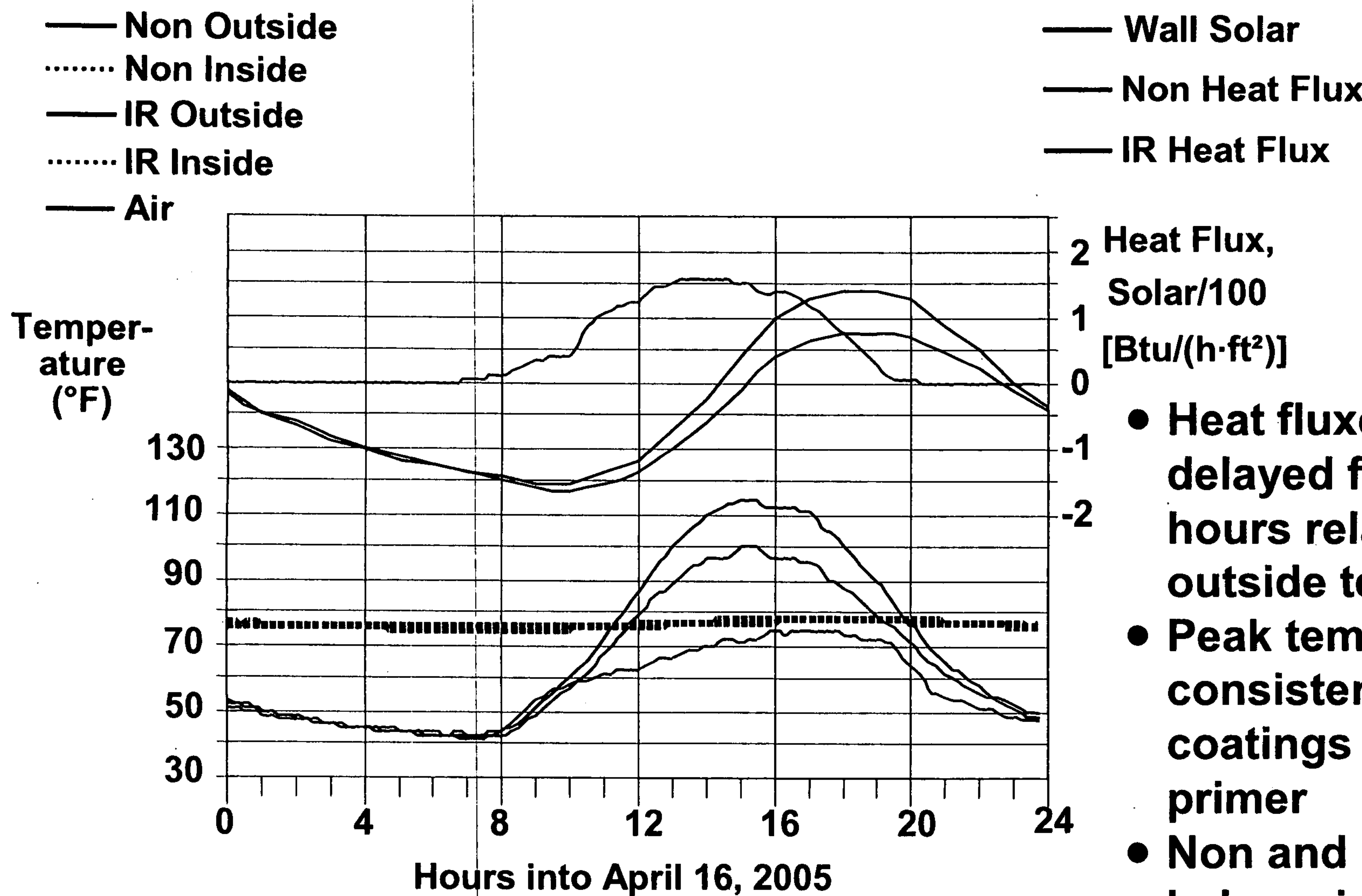
- Computer dedicated to ESRA data acquisition records detailed thermal performance



ORNL Site

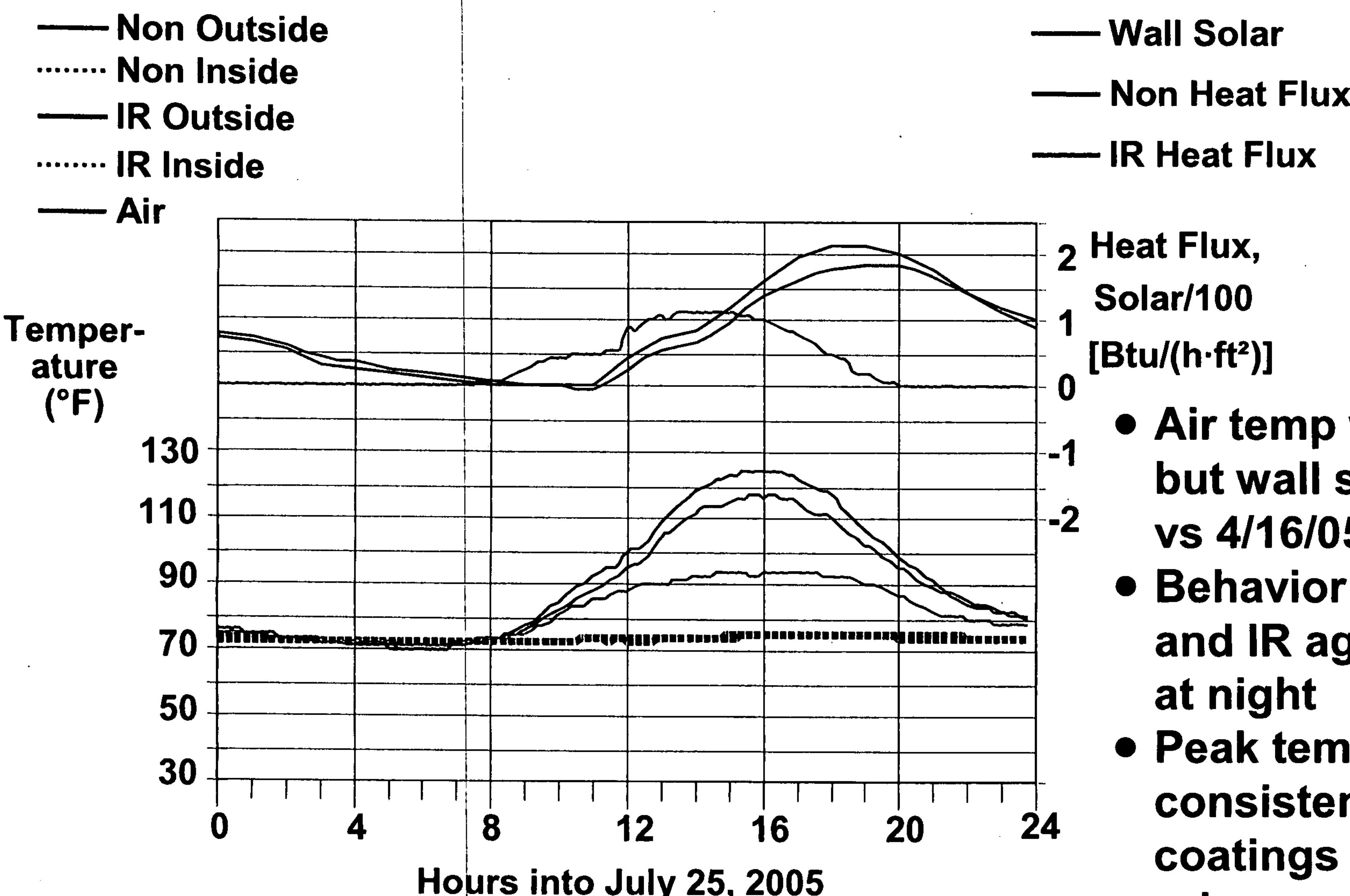
- Data starting 7/30/04 with coating on 8/3/04. Data acquisition through August 2005
- Check consistency of data with program to estimate wall properties from temperature and heat flux measurements. Data very consistent from month to month
- Behavior of solar radiation control on vertical walls more complicated than low-slope roofs. Difficult to generalize simply

ORNL Site: Non vs IR -- Spring Day



- Heat fluxes delayed four hours relative to outside temp
- Peak temps consistent with coatings over primer
- Non and IR behave identically at night

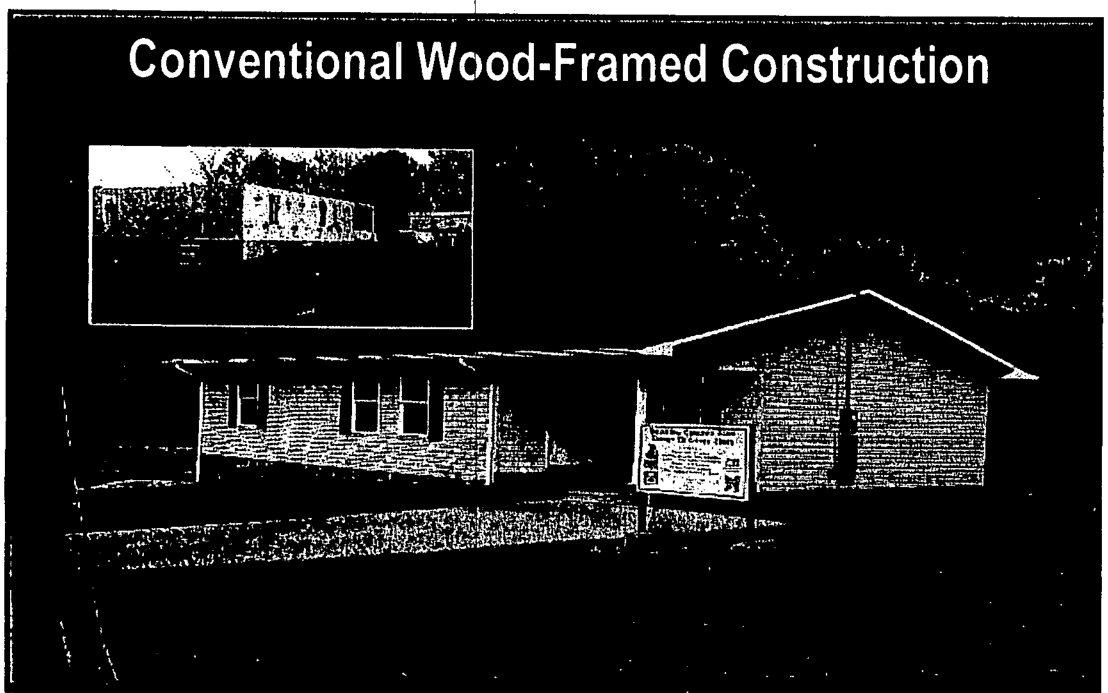
ORNL Site: Non vs IR -- Summer Day



- Air temp warmer but wall solar lower vs 4/16/05
- Behavior of Non and IR again same at night
- Peak temps again consistent with coatings over primer

Model for Wall Behavior

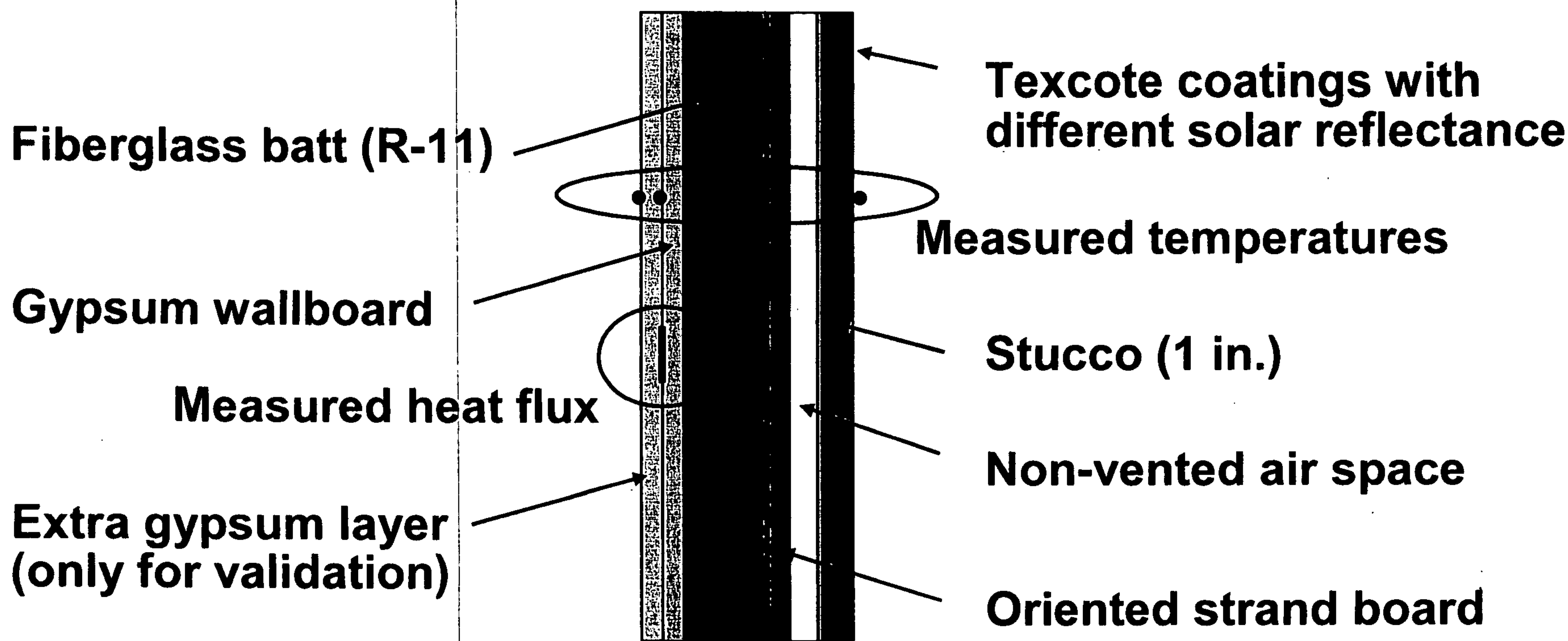
- Seek a model that can be generalized to give results for whole buildings
- Have done extensive validation of a model in DOE 2.2 for a 1100 ft² ranch house



- Heat/cool with heat pump: 68°F winter; 76°F summer; size heat pump for climate
- Occupy with 3 people + Building America energy use profiles

Model for Wall Behavior

- To validate model, generate climatic data from ORNL weather station records for year of test
- Use properties of wall materials along with construction details for test section



Solar Reflectance of Coatings

- **Samples over primer: Mountain Gray (Phoenix) and Underseas (Jacksonville and ORNL) 7/2/04**

Mountain Gray Supercote Platinum	0.44
Mountain Gray Supercote	0.30
Underseas Supercote Platinum	0.51
Underseas Supercote	0.25

- **Jacksonville on wood siding and existing coating 12/8/04**

Underseas Supercote Platinum	0.40
Underseas Supercote	0.24

- **ORNL on Stucco**

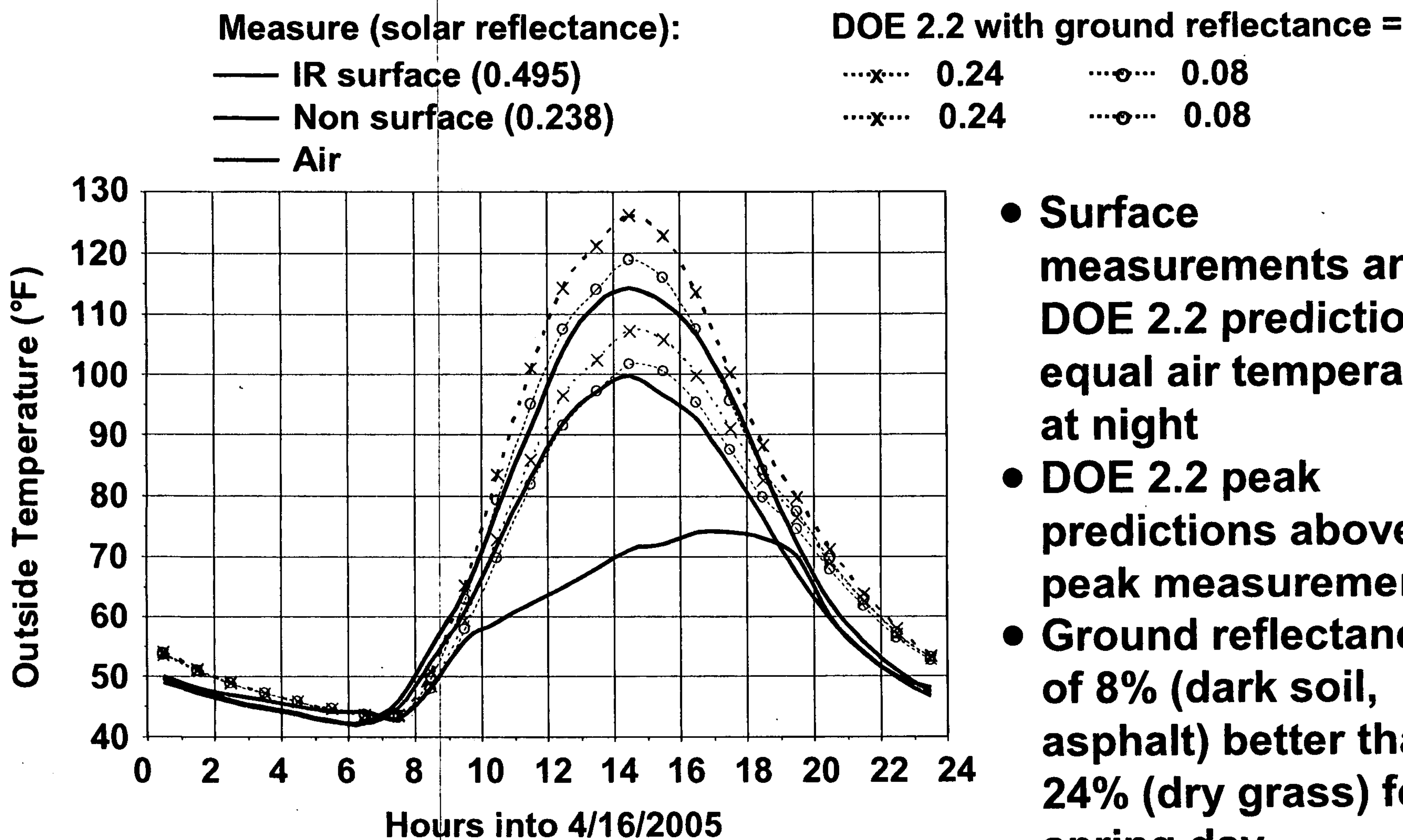
	8/4/04	9/27/04	5/18/05	8/3/05	
Texcote Primer	0.71	0.67	0.72	0.66	
Underseas Supercote Pt	0.49	0.50	0.49	0.49	0.50
Underseas Supercote	0.24	0.24	0.24	0.24	0.24

Use averages

Features of DOE 2.2 of interest

- Can specify wall and solar reflectance of exterior surface and nearby ground
- Sun tracked hour by hour and can shade exterior surfaces by building and landscape
- Simulation of annual energy use by heating and cooling system includes response to thermostat schedules and to thermal mass in envelope

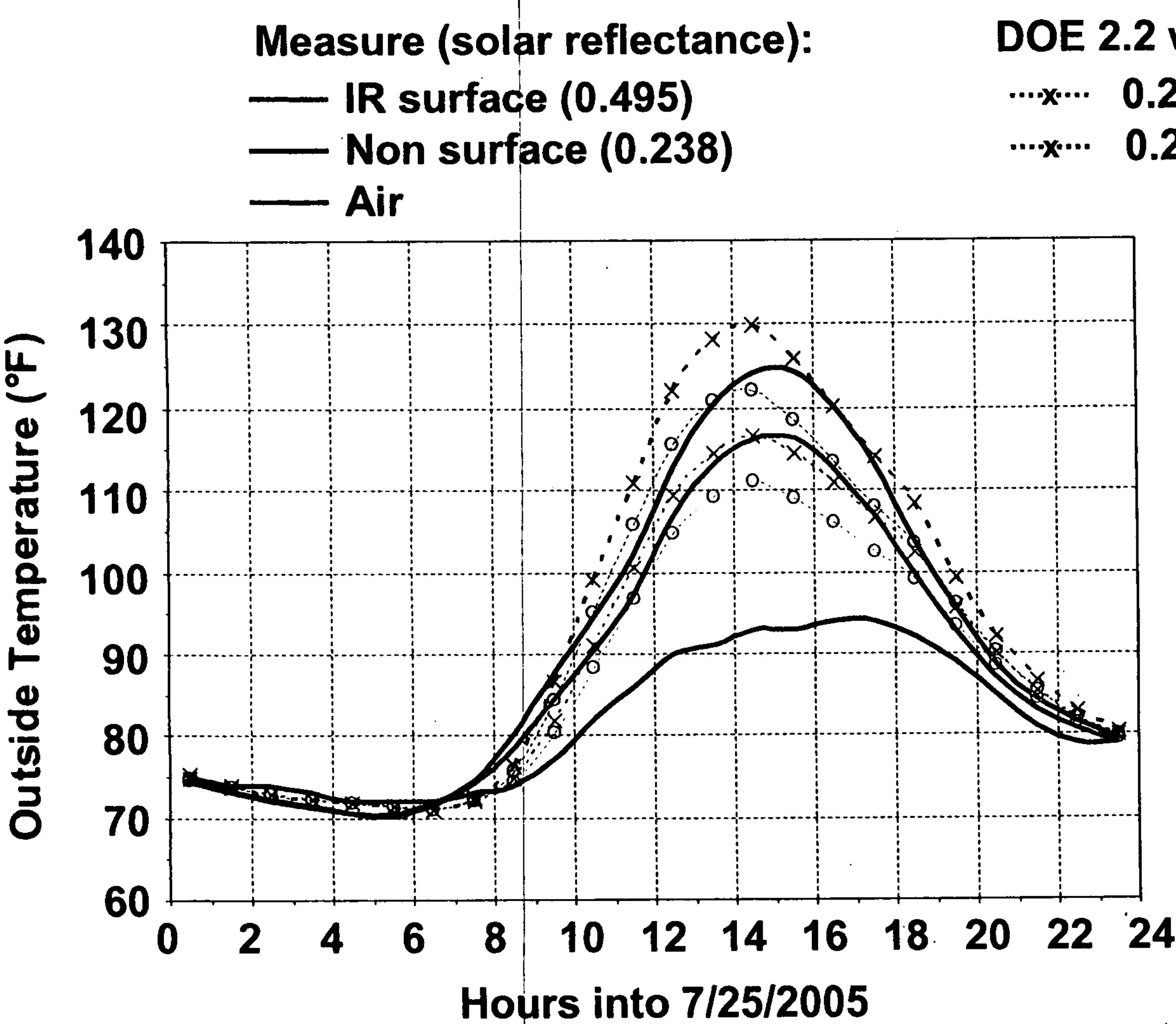
Model of South Wall vs Measurement:
Temperatures at Outside – Spring Day



- Surface measurements and DOE 2.2 predictions equal air temperature at night
- DOE 2.2 peak predictions above peak measurements
- Ground reflectance of 8% (dark soil, asphalt) better than 24% (dry grass) for spring day

Model of South Wall vs Measurement:

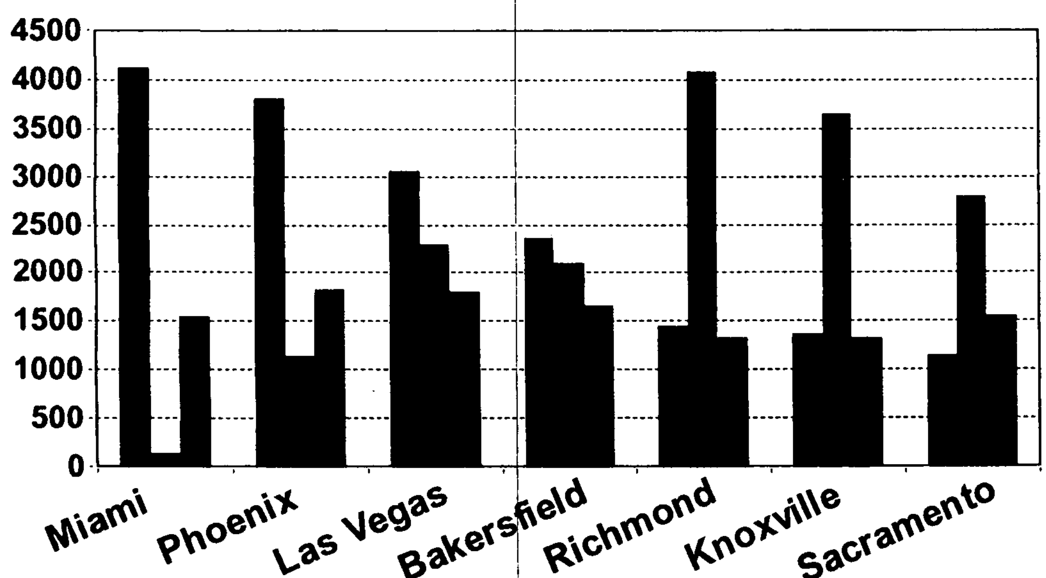
Temperatures at Outside – Summer Day



- DOE 2.2 peak behavior vs measurements not as regular as for 4/16/05
- Ground reflectance of 24% (dry grass) closer than 8% (dark soil) for this summer day.

Model Generalizations

- Building America Performance Analysis Resources at http://www.eere.energy.gov/buildings/building_america/pa_resources.html gives energy use profiles for three occupants (3 BR home). Choose to heat and cool with air-to-air heat pump (76°F cooling; 68°F heating; no setup or setback)
- Choose seven different climates to show response of typical house to cooling and mixed climates of interest

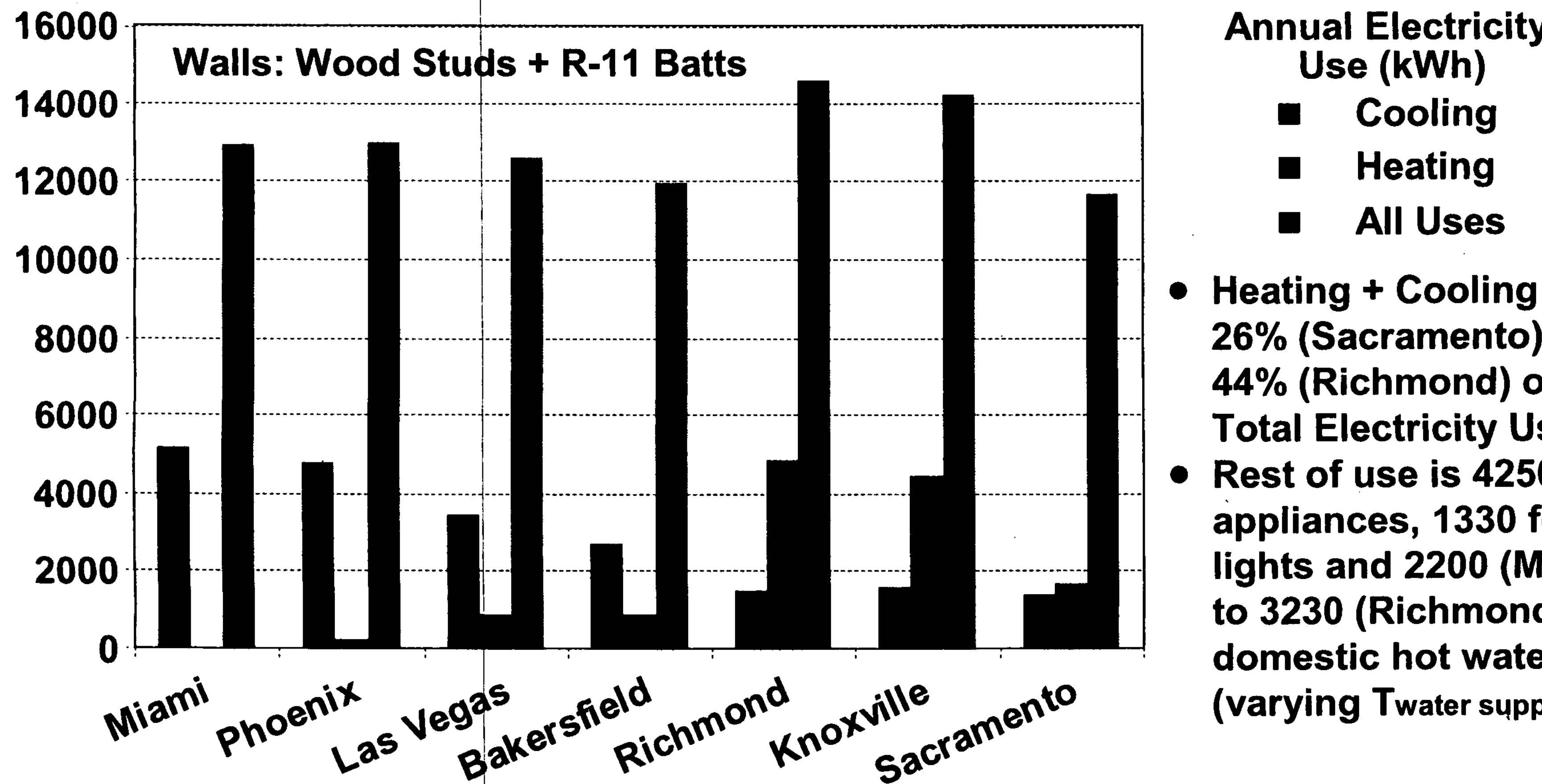


- CDD65 (°F-day)
- HDD65 (°F-day)
- Average Daily Solar (Btu/ft²)

- Cities arranged by decreasing cooling degree days

Model Generalizations

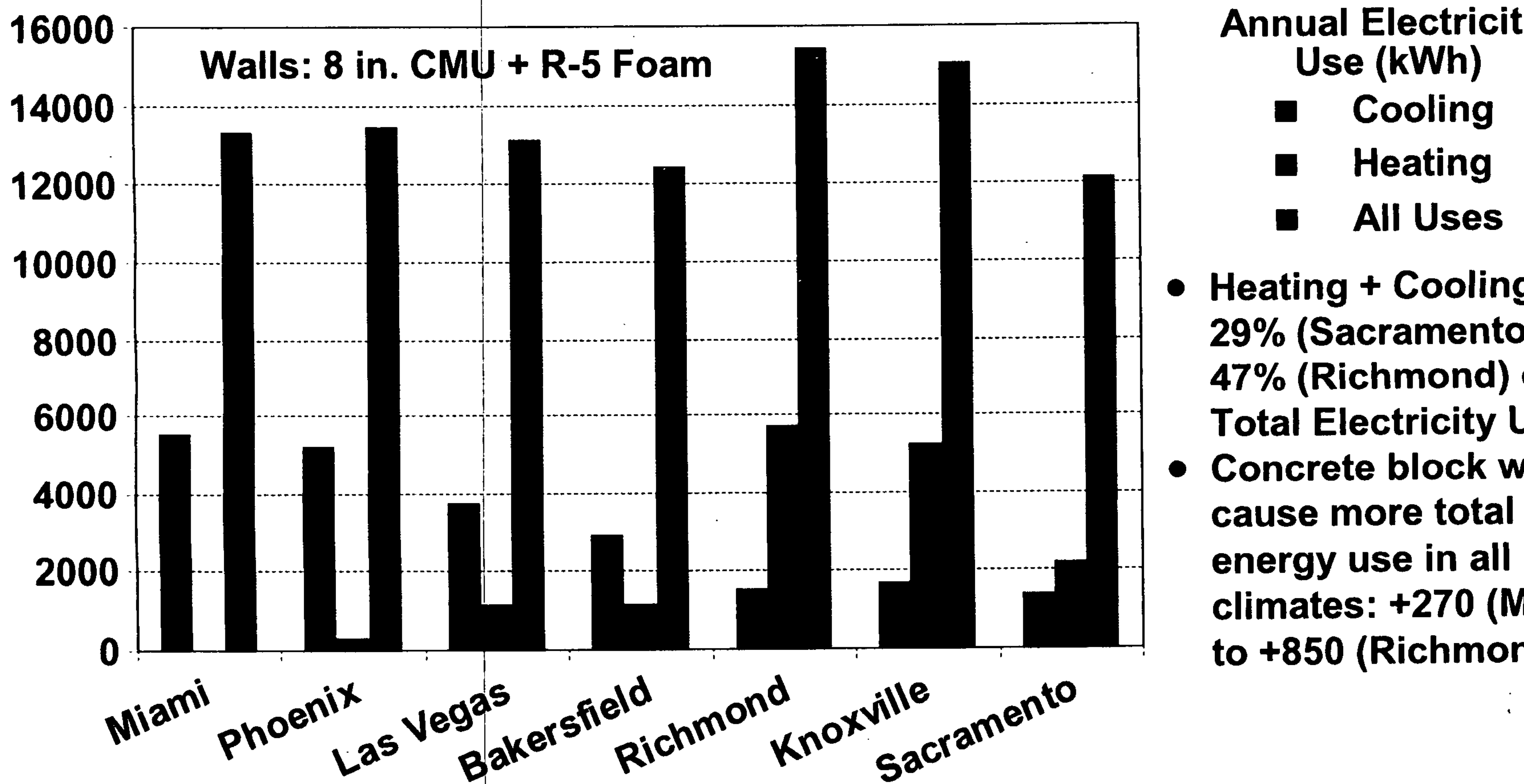
- Ranch house with non-IR reflecting coating on walls shows variation in heating and cooling energy use that is consistent with climate variation



- Heating + Cooling is 26% (Sacramento) to 44% (Richmond) of Total Electricity Use
- Rest of use is 4250 for appliances, 1330 for lights and 2200 (Miami) to 3230 (Richmond) for domestic hot water (varying $T_{water\ supply}$)

Model Generalizations

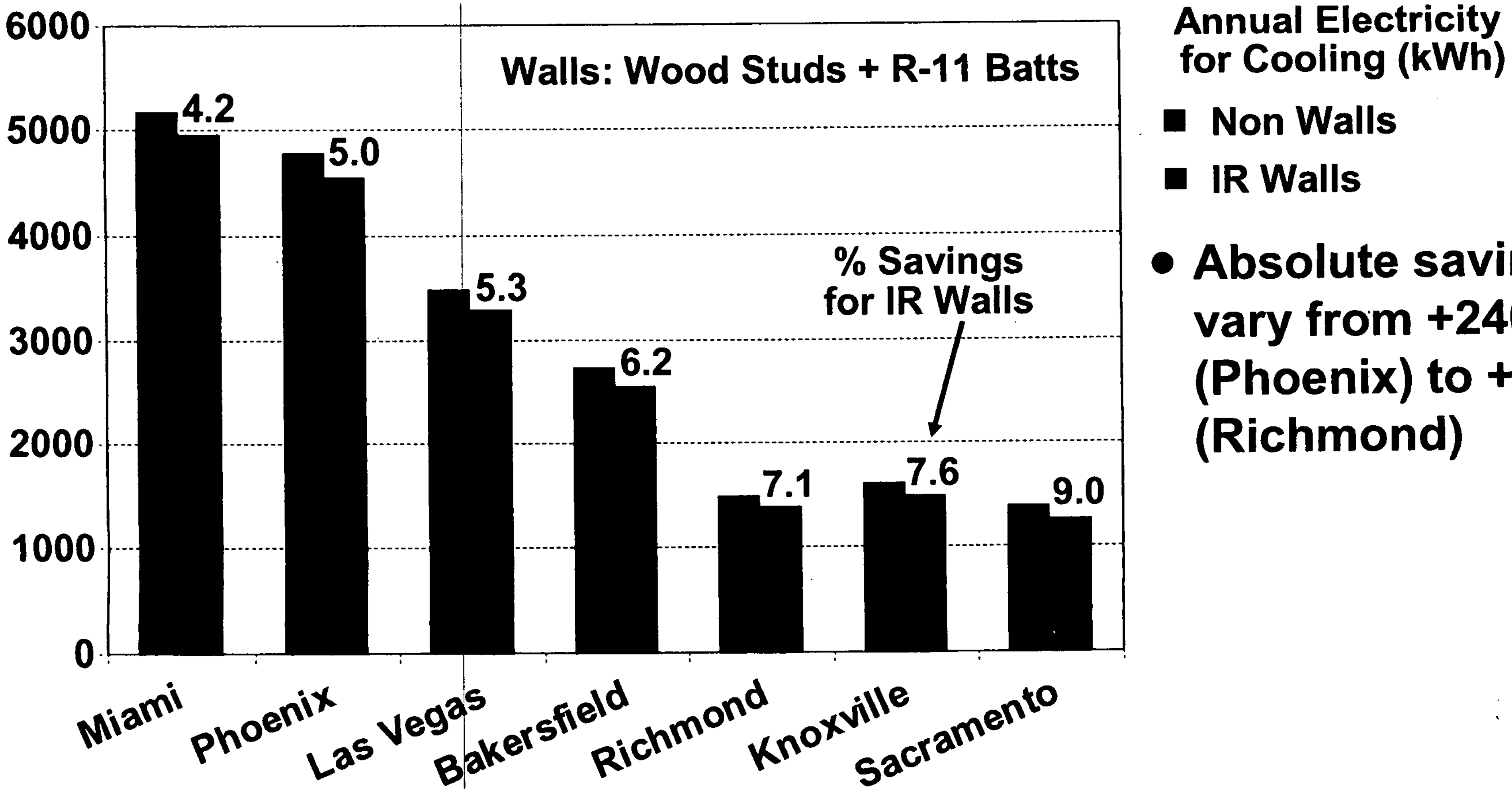
- Alternate wall configuration of interest for cooling climates. Keep attic and floor insulation levels for consistency



- Heating + Cooling is 29% (Sacramento) to 47% (Richmond) of Total Electricity Use
- Concrete block walls cause more total energy use in all climates: +270 (Miami) to +850 (Richmond)

Model Generalizations

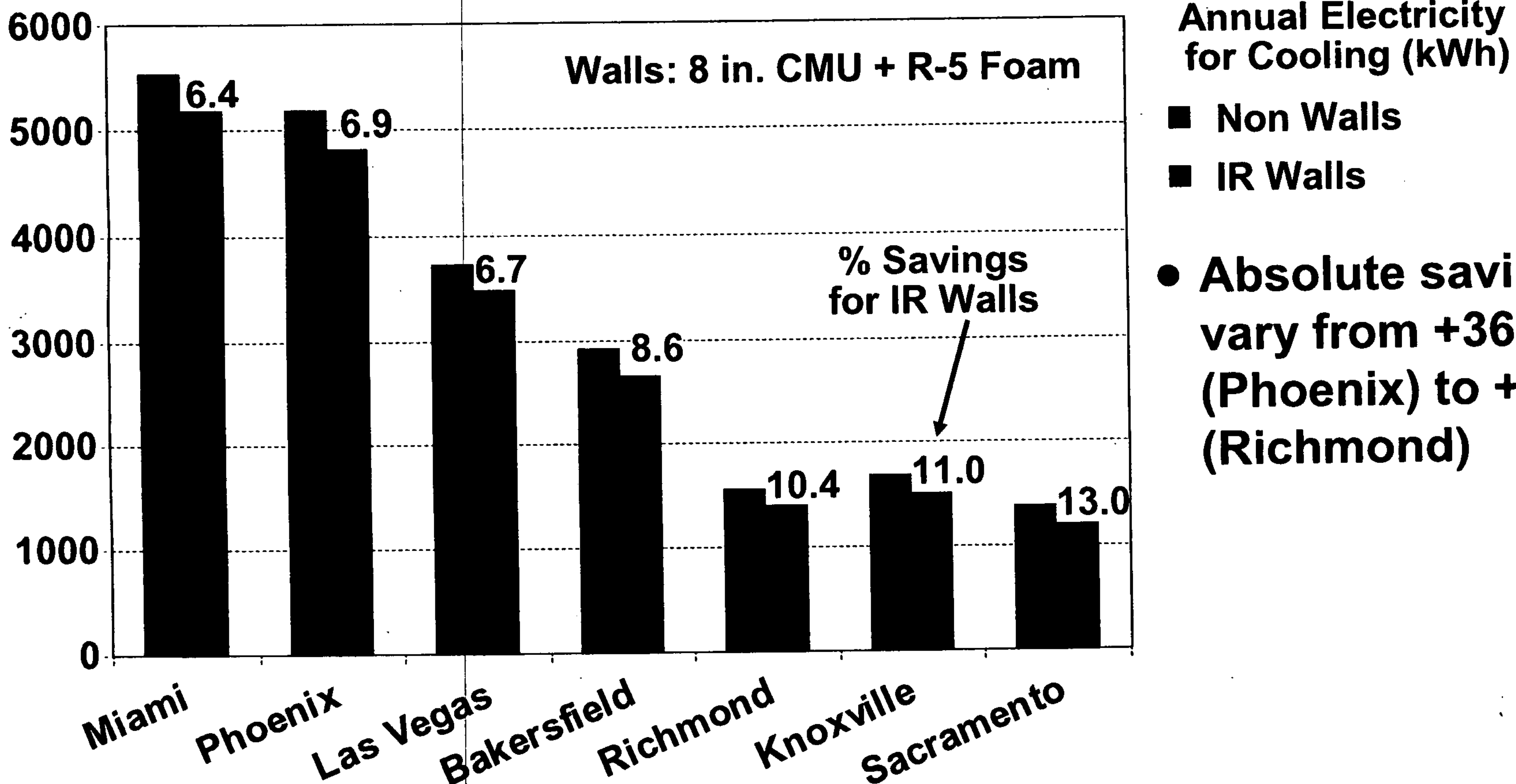
- IR reflective coating on conventional walls saves cooling energy. Savings are 4% to 9% compared to non-IR reflecting walls



- Absolute savings vary from +240 (Phoenix) to +110 (Richmond)

Model Generalizations

- IR reflective coating on CMU walls shows larger savings of cooling energy. Savings are 6% to 13% compared to cooling energy with non-IR reflecting walls

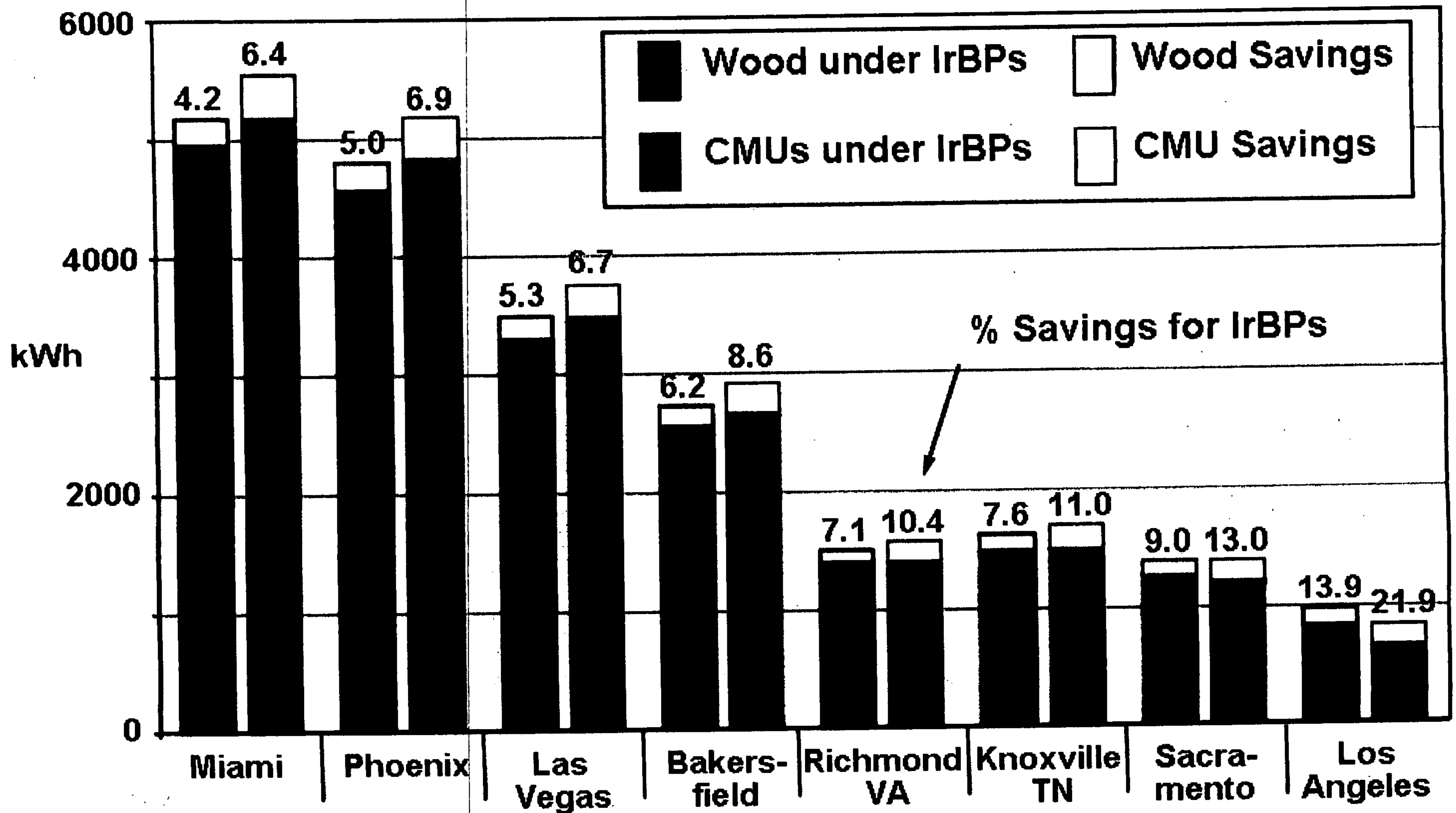


- Absolute savings vary from +360 (Phoenix) to +160 (Richmond)

Project Summary

- Demo sites in Phoenix and Jacksonville depict energy savings
- Full year of ORNL data validated DOE 2.2 model
- Complexity of real wall applications (different orientations, shading and construction) makes generalization very difficult
- DOE 2.2 whole building annual energy estimates for ranch house show that IR reflecting pigments save 4% to 13% of cooling energy

- Cooling a 1100 ft² ranch house in various climates



UT-BATTELLE

Field Tests of Cool Walls in Cooling and Mixed Climates

Questions or comments?

OAK RIDGE NATIONAL LABORATORY
U. S. DEPARTMENT OF ENERGY